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THE SPONTANEOUS COMBUSTION OF COAL ON BOARD SHIP.

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Wednesday, 27th November, 1901.
Admiral the Hon. Sir E. R. FREMANTLE, G.C.B., C.M.G.,
in the Chair.

THE carriage of coal on board ship—at any rate in large quantities—involves three elements of danger, namely, from its spontaneous combustion, from the explosion of the gases it gives off, and from its liability to shift in heavy weather.

Put it is only the first of the elements of danger just enumerated that we are considering to-day, the two latter being readily guarded against, and the subject is brought forward for consideration and discussion in the belief that the spontaneous combustion of coal on board ship, its causes, and the best methods of preventing it, have a natural interest for seafarers generally, whether members of the Royal Navy or of the Mercantile Marine; and although this paper principally treats of the conveyance of coal cargoes on long voyages, the same governing principles will no doubt be found of considerable value when applied in other directions.

At the same time, I can take but little personal credit for the paper, as I am mainly giving, in a shortened form and through the medium of lengthy quotations, information that is to be found in certain blue-books and official reports—a class of literature, however, that is neither very extensively circulated nor largely read.

Some years ago, owing to the number of casualties constantly occurring to vessels laden with coal, a Royal Commission was appointed "to make enquiry with regard to the causes of the spontaneous combustion of coal in ships, and the remedies which it may be possible to adopt for preventing and guarding against the same," and this Commission, which was presided over by the late Rt. Hon. C. E. Childers, presented its report on 18th July, 1876.

Seen in the light of the recommendations contained in that report, it is particularly and interestingly noteworthy that "in April, 1874, the Board of Trade decided to hold no more enquiries under the Merchant Shipping Act into casualties caused by explosions or fire in coal-laden vessels, for the reason that the finding of their courts, which invariably took the form of an exoneration of the ship's officers and a recommendation in favour of better ventilation, appeared to be entirely disregarded both by shipowning and underwriting interests."

However, after coming to this determination, the Board of Trade had some correspondence with the Committee of Lloyd's, the Salvage Association, and others, which led to the appointment of the above-mentioned Royal Commission.

One may here digress for a moment to remark that whereas in 1874 the amount of coal exported from the United Kingdom was about 13,500,000 tons, it had risen last year to about 44,000,000 tons, to which must be added 11,750,000 tons for ships' use on foreign voyages.

A return for 1874, prepared by the Committee of Lloyd's for the use of the Royal Commissioners, showed that the shipments of coal to European ports only suffered from spontaneous combustion in a minor degree, the great bulk of the casualties, as might reasonably have been expected owing to the greater length of the voyages, occurring to the shipments of coal to Asia, Africa, and America.

Another great and interesting point established by it was that the proportion of casualties traceable to spontaneous combustion increased *pari passu* with the tonnage of the cargoes.

Very interesting reasons, deduced from more modern experiments, will be given later on, in order to show why this should have been the case.

Among shipments to other than European ports, the casualties for cargoes under 500 tons were about ¼ per cent.; for cargoes between 500 and 1,000 tons, about 1 per cent.; for cargoes between 1,000 and 1,500 tons, about 3½ per cent.; for cargoes between 1,500 and 2,000 tons, about 4½ per cent.; and for cargoes over 2,000 tons, about 9 per cent.

Vessels bound to San Francisco were particularly unfortunate, as deducting vessels under 500 tons (in which no cases were recorded) no

less than 9 casualties occurred among 54 shipments; while of 5 ships with cargoes of over 2,000 tons, 2 suffered.

One of the chief points that the Commissioners concentrated their attention upon was the descriptions of coal that are dangerous for long voyages, and upon this question they remarked:—"This is a very difficult and delicate, and, at the same time, a very important branch of our inquiry. There can be no doubt that certain kinds of coal are of such a quality as to be entirely unsafe for shipment at all, while other kinds should only be shipped for short voyages and under circumstances of great precaution. . . . It would, however, be of course impossible for us to cite with completeness or accuracy the various coals to be avoided, or their relative susceptibilities to spontaneous heating. The difficulties are two-fold: first, because coals of very different character in this respect are produced from the same colliery; and, secondly, because the conditions of shipment may be totally dissimilar. Nor can chemical analysis be relied upon in every case to furnish conclusive evidence as to the tendency to ignition."

However, the order of liability to spontaneous combustion appears to run thus:—

1. Lignite.
2. Gas coal.
3. Coking coal.
4. Anthracite.

The breaking of the coal during shipment was another point that received great attention at the hands of the Commissioners, the danger of small coal, particularly when accumulated in heaps under the hatchways, being then as now fully recognised. Various plans for preventing this breakage and poundage were, and have been, adopted from time to time with varying success, but the tendency of the age is to hurry along, and any device that even in a slight degree is likely to cause delay in the loading of a vessel is hardly likely to be looked upon with a favourable eye. As an instance of extraordinary despatch, also said to be coupled with comparatively practical immunity from breakage of the cargo, it may be mentioned that towards the end of July of the present year, the steamship "Bangarth" took on board from the new tips in Penarth Dock Basin 2,155 tons of coal, including bunkers and cargo, in the almost incredibly short space of one hour and fifty-five minutes. This question of the breakage of coal during shipment will be referred to again more than once later on.

Speaking about wet coal, the Commissioners said:—"Most of the witnesses who have come before us have strongly condemned the shipment or carriage of coal in a wet condition, and their experience in this respect is, to a certain extent, supported by the scientific evidence to

which we would direct very careful attention. It would appear that the wetting of certain kinds of coal, more especially those containing pyrites, is active in promoting spontaneous combustion; but the statements of some of the witnesses lead to the impression that moisture has been credited with cases of combustion beyond the sphere of its operation; while from other passages of the evidence, it appears to us that the influence of the water, existing to a greater or less extent, in all coal before it has been brought to the surface has not been sufficiently recognised."

Bearing upon this point, the following paragraph is to be found in a memorandum drawn up by Dr. Percy and Professor (now Sir Frederick) Abel, two of the Royal Commissioners:—"Spontaneous ignition of coal, when due to the oxidation of the porous and readily oxidisable carbonaceous substances occurring in coal does not appear to be favoured by the presence of water in the coal or by its access to a cargo; on the contrary, these portions, by becoming wet, would have their pores more or less filled with water, and their power of absorbing oxygen would be proportionately diminished, hence the presence of water must be antagonistic to the oxidising action of the latter in many instances, though, when iron pyrites is present, it may promote or accelerate spontaneous heating as already pointed out."

The next great question that occupied the attention of the Royal Commissioners was that of the through ventilation of coal cargoes.

At that time the method of ventilation usually adopted—although the owners and masters of some ships deemed this ventilation unnecessary and did not provide it—consisted of wooden venetianed shafts, about 2 feet square, run down to the bottom of the hold in the hatchways, and there connected with a box-shaft running along the keelson or into a space below the platform. Sometimes these shafts were carried up through the hatchways and fitted with cowls, so as to form a down-take and an up-take for circulating the air, but they were frequently only brought near the top of the hatchways, and so were covered when the hatches were on.

However, the whole subject was little understood, and in the case of official enquiries into casualties the omission to provide through ventilation was looked upon in the light of a default.

The scientific reasons formed in opposition to through ventilation will appear later on, but the Commissioners gave the following instances as practical evidence against that system:—"Of the 70 ships that suffered in 1874, none are reported as not having been ventilated, while 38 are distinctly stated to have been ventilated, 35 of them being vessels over 500 tons. But the most startling illustration is furnished by the cases

of four vessels, the 'Euxine,' 'Oliver Cromwell,' 'Calcutta,' and 'Corah.' These ships, to which reference was made by several of the witnesses who appeared before us, were loaded under the tips at Newcastle, at the same time, with the same coal, and from the same seam, sometimes one ship being under the tip and sometimes another. They were each carrying from 1,500 to 2,000 tons of coal. The 'Euxine,' 'Oliver Cromwell,' and 'Calcutta' were bound for Aden, the 'Corah' for Bombay. The first three ships were thoroughly ventilated, the fourth was not ventilated at all. The 'Euxine,' 'Oliver Cromwell,' and 'Calcutta' were all totally lost from spontaneous combustion. The 'Corah' carried her cargo safely to Bombay." They also mentioned the case of the "Theresa" and the "Anglia." Those vessels were owned by the same firm, and were loaded from the same colliery, the "Theresa," for Rangoon, being extensively ventilated, while the "Anglia," for Havannah, had no ventilation. The "Theresa" became a total loss from spontaneous combustion when she had been at sea a little over two months, but the "Anglia" reached her destination in safety after a passage of 69 days, although her cargo was very hot when discharging.

The last point considered by the Commissioners appears to have been the best method of extinguishing a fire, should one unfortunately break out, and regarding this they said:—"Several methods for generating carbonic acid gas and applying it to the ignited portions of a coal cargo have been proposed for our consideration. We consider, however, that although this gas might be useful, by excluding atmospheric air (which is essential to support combustion), yet it will not, as water does, exert any very sensible cooling effect, which is a point of vital importance in the case of a considerable mass of ignited coal. We are of opinion that water and steam are the only agents practically available for the purpose of extinguishing fire in coal cargoes."

The following appear to be the principal items for our purpose contained in the summary of the Report of the Royal Commission of 1876:—

a. That certain descriptions of coal are intrinsically dangerous for shipment on long voyages.

b. That the breakage of coal in its transport from the pit to the ship's hold, the shipment of pyritic coal in a wet condition, and *especially ventilation through the body of coal cargoes*, conduce to spontaneous combustion, even though the coal may not be unfit for conveyance on long voyages.

c. That spontaneous combustion in coal cargoes would be less frequent, if regard were had by shipowners and underwriters to these facts.

d. That when coal is being carried on long voyages the temperature in the various portions of the cargo should be tested periodically by thermometer, and registered in the log.

e. That in order to make known the descriptions of coal liable to spontaneous combustion, the Inspectors of Mines should be instructed to hold enquiry into all cases of spontaneous combustion occurring in cargoes of coal taken from their respective districts, exporters being required always to record on their specifications the denomination of the coals forming the cargo.

Although *through ventilation* was condemned, *efficient surface ventilation*, designed to carry off the gas which would otherwise accumulate and might bring about an explosion, was recommended.

The Report of the Royal Commission of 1876 seems to have been generally understood as condemning the shipment of all wet coal, and that understanding has formed the basis of the findings of many Courts of Inquiry up to a recent date. Moreover, in "The King's Regulations and Admiralty Instructions," article 523, paragraph 25, still reads as follows:—"Coal should not be taken on board wet, as moisture sometimes causes a rapid and dangerous generation of heat and gas. . . . . Coal should always be kept as dry as possible." And yet, from two paragraphs I have read—one extracted from the report and the other from the Scientific Memorandum accompanying the report—it will be seen that there was not the wholesale condemnation of the carriage of wet coal imagined, but rather a condemnation of the carriage of wet coal containing much pyrites.

From the results of enquiries into the causes of casualties from spontaneous combustion held since the issue of the 1876 report I had made many extracts, but as those findings as extracted mainly ascribed the accidents to the presence of wet coal, or to the presence of wet coal containing pyrites (this latter being in accordance with the summary of the report), I decided to omit them owing to the exigencies of space.

As the name "pyrites" looms large in this paper, it may be well at this stage to say a few words regarding it; and through the kindness of a friend I have with me a few specimens found in coal.

Referring to "Chambers' Encyclopædia," I find that:—"Pyrites is a name employed by mineralogists to designate a large class of minerals which are composed of metals with sulphur or with arsenic, or with both. They are crystalline, hard, generally brittle, and frequently yellow . . . . . It is too abundant in many coal seams, the action of water and air changing it into sulphate of iron (vitriol), during which change so much heat is evolved that the coal is frequently kindled by it, mines

become unworkable, and the progress of the fire can only be stopped, if at all, by building up portions of them to cut off the access of air, or by the admission of a plentiful supply of water." Also the statement is made that there have been many instances of the spontaneous ignition of coal containing iron pyrites, when moistened with water.

As, for instance, there are iron pyrites, copper pyrites, and cobalt pyrites; so pyrites are found in various substances other than coal, and no doubt their susceptibility to weathering also varies.

Some may readily yield, but Mr. Louis Bernacchi during the recent voyage of the "Southern Cross" to the Antarctic regions, saw in South Victoria Land crystals of pyrites disseminated through the greenish slatey rock: "And they appeared to yield but slowly to weathering, for generally the cubical crystal could be seen projecting still fresh from the stone, which had no doubt been long exposed to the atmosphere, and a small blow would, in many cases, loosen the entire crystal from the rock."

On July 28th, 1896, a Royal Commission, consisting of Professor Richard Threlfall, F.R.S., M.A., and Mr. Edward Fisher Pitman, F.G.S., A.R.S.M., was appointed by Viscount Hampden, Governor of the Colony of New South Wales: "To make a diligent and full enquiry into the cause of the dangers to which vessels carrying coal are said to be particularly liable, and as to the best means that can be adopted for removing or lessening the same."

It seems that during the year 1895, out of 294 ships which sailed from Newcastle, N.S.W., for America, 6 were either burnt or the cargoes became hot, while in the first nine months of 1896 the number was 4 out of 200.

Designedly, nothing has hitherto been said about the theory of the spontaneous combustion of coal, for that theory has been put forward so simply and clearly, and I think I may say so conclusively, in the report of the first New South Wales Commission, that I am taking the liberty of quoting it almost *in extenso*.

The Commissioners said:—"Coal naturally absorbs oxygen from the air and undergoes a process of slow combustion. As this process goes on heat is developed, and the temperature of the coal tends to rise. The activity with which oxygen is absorbed increases as the temperature rises. It appears, therefore, that the conditions necessary for the spontaneous heating of coal are: (1) a sufficient supply of oxygen, (2) prevention of the escape of the heat generated. These two conditions are more or less incompatible. Whether the coal heats or not depends on whether the heat can or cannot escape as fast as it is generated. Since heat passes away more rapidly (other things being equal) the hotter the coal, while the supply of air for promoting combustion is conditioned by other

circumstances, it often happens that the temperature of a heap of coal will rise to a certain point, which it will not pass.

"If a heap of coal is prevented from coming in contact with air, no action will occur and no heat will be developed. On the other hand, if the air supply be so free as to carry away the heat generated at a sufficient rate, again, no heating will take place. In order that spontaneous combustion may occur, the supply of air must be nicely regulated. The kind of ventilation which used formerly to be employed with coal cargoes often supplied just the air necessary for spontaneous heating. At low temperatures the absorption of oxygen by coal is a comparatively slow process, and, at a given temperature, the rate of absorption depends on the *ratio* of the surface of the coal to its volume. Thus, other things being equal, the smaller the coal the more rapidly it will absorb oxygen. On the other hand, the coal cannot absorb oxygen unless the oxygen is there to be absorbed, and when the coal is in very fine dust the rate at which the air can penetrate the heap is only small. It, therefore, appears that when the coal is in large pieces it will only absorb oxygen slowly, because of the comparatively restricted area of surface which it exposes; while, if the coal is in very fine powder, the air will not be able to penetrate the mass with sufficient freedom. There must, therefore, be a certain size of coal at which the rate of absorption will be a maximum. Such an effect was observed by Fayol, who shows that heaps of small coal mixed with coal-dust offers the most favourable conditions for heating. Such heaps are formed under the hatchways of ships which are loaded by dropping the coal from hoppers, spouts, or wagons, so that the coal gets broken up during the process.

"The size of a heap of coal has a great influence on its liability to spontaneous combustion. Thus Fayol found that the coal of Commentry never took fire by exposure to air when the heaps were less than 2 metres deep, no matter what the lateral dimensions of the heaps might be.

"We obtained some valuable evidence on this point from Mr. Bush, the engineer of the Australian Gaslight Company. It appears that the Australian Gaslight Company has two coal stores—one at Kent Street, the other at Mortlake. These stores are kept more or less full of slack for gas-making. The Kent Street store is filled with coal to a depth of 14 feet; the Mortlake store to a depth of 20 feet. The Mortlake store requires great care to prevent the coal firing, whereas no case of firing from spontaneous combustion has occurred at Kent Street. All other circumstances are, so far as are known, exactly the same at both stores. The opinion of Mr. Bush, with which we agree, is that the cause of the difference in the behaviour of the coal in the two stores is to be attributed to the difference of depth of the coal. The importance of this will appear later on.

"It was formerly supposed that the oxidation of pyrites (a common impurity of coal) is the initial cause of spontaneous heating. This, however, has been disproved in many test cases by direct experiment, and it also appears that there is no direct relation between the pyrites content of coal and its liability to spontaneous combustion. On the other hand, if coal is wet it has been shown that the pyrites tends to oxidise, and in so doing may help to break up the coal, and so render it more liable to spontaneous combustion by increasing the surface. We are of opinion, however, that the cases of spontaneous combustion of Newcastle coal are not in any way traceable to this action, since we have not been able to find that the cargoes which have fired have been unusually wet, or that the sulphur content was unusually high; in fact, the average sulphur content is only about 0·5 per cent.

"It must still be regarded as an open question, however, whether the heating of Newcastle coal is in any way dependent on the amount of moisture which it contains. On the one hand, we have the very definite experimental result of Fayol that moisture has no influence whatever on the liability to spontaneous combustion of the coal of Commentry; and, on the other, we see that the disintegrating action of oxidising pyrites may have an indirect effect.

"Most of the witnesses we examined were of the opinion that coal was more likely to fire when wet; and some important evidence was given us by Mr. A. Ross, Manager of the Wallsend Mine, also by Mr. Reed, Screen Overseer, in charge of the hoppers in which the Newcastle-Wallsend Coal Company store their small coal. These witnesses stated that the temperature of the coal in the Wallsend hopper increased within a few days after a shower of rain. On visiting the hopper, and digging into the coal to a depth of two or three feet, we obtained samples of coal some hot and moist, others dry and cool. The place whence the hot sample was obtained was distant only a few feet from the place where the cold sample was taken. Chemical examination disclosed no appreciable difference between the samples. It occurred to us that possibly the hot coal had been heated by the distillation of steam from the coal below, which was spontaneously heated, and this, we are inclined to think, was really the case, for the seat of spontaneous combustion is never within three feet of the surface of a heap of coal. On drawing Mr. Reed's attention to the possibility of this explanation, he appeared inclined to agree with us. We consider it not unlikely that the heating up of otherwise unheated coal by the distillation (and condensation) of steam may have given rise to the idea that moisture is favourable to spontaneous heating.

". . . . . At present, our impression is that moisture has no effect in promoting spontaneous combustion.

"It is, perhaps, obvious from what has been said on the subject of the absorption of oxygen by coal, that a very important condition is the initial temperature of the coal. From two cases which came under our notice, we are inclined to think that the masters of ships are not sufficiently alive to the importance of keeping the coal away from hot surfaces, especially when these surfaces are themselves far below the ignition point of coal. A donkey-engine and boiler, for instance, may be separated from the hold by a cement floor laid on the deck planking, and—so far as we could ascertain—there seemed to be an impression that the heat which could be transmitted through such a shield could have no ill-effect on the coal. The fact is, however, that the rate of absorption of oxygen increases so greatly with rise of temperature, that the moderate warming of the coal by a steam pipe or boiler may enormously shorten the time necessary for spontaneous combustion to set in, or may render spontaneous combustion possible in cases where it would otherwise be impossible.

"These remarks apply with great force to the practice of loading coal in very hot weather. The coal lying in trucks on the dyke and exposed to the sun is loaded at a temperature which it might take months to reach if it had to generate the necessary heat by absorption of oxygen. This reasonable conclusion is supported by the fact—sad, but significant—that three very large ships loaded together during the hot weather of January, 1896, and all three were the victims of spontaneous combustion.

"The acceleration of the rise of temperature, consequent on a large initial temperature, is also well illustrated by the cases of the 'Knight of St. Michael,' the 'Morna,' and the 'Invermay,' all of which were loaded during extremely hot weather, and all of whose cargoes became dangerously heated within a short time of loading.

"We are now in a position to understand the main features of the phenomena of the spontaneous combustion of coal. Coal always absorbs oxygen from the air, and always generates heat in consequence of the combination of the oxygen with the carbonaceous contents of the coal. The rise of temperature, however, which accompanies this process is dependent on the rate at which oxygen is absorbed, on the one hand, and on the rate at which heat escapes, on the other. Both of these factors may be greatly influenced by comparatively trifling variations in the conditions. The size of the coal, the distribution of coal-dust, the initial temperature of the coal, the temperature of the enclosure in which the coal is placed, the size of the heap of coal—all have an effect on the temperature attained. To anyone approaching the subject for the first time, the great puzzle is to understand why some cargoes fire and why others escape—all being under conditions which are to the first order identical. After study of the phenomena, however, it easily appears that there must necessarily be a kind of critical temperature. If the coal

succeeds in reaching this, then its thermal equilibrium becomes unstable and the temperature rises indefinitely. A very slight difference in the conditions will determine whether this critical temperature, which itself depends on special circumstances, is attained or not. The puzzle above referred to is, therefore, solved by the remark that when some cargoes fire and others do not, the conditions are *not* the same in reality, though, roughly speaking, they may appear to be so. The apparently erratic behaviour of coal cargoes is, therefore, just what would be expected, having in view the fact that *very slight variations* in the circumstances may make all the difference in determining whether the critical temperature will be passed or not."

Further on in the report the Commissioners wrote:—"From what has already been said with respect to the experiments of Fayol and the experience of Mr. Bush, a difference of even 1 foot in the depth of the hold may be of immense importance in determining whether coal in a suitable condition as to size shall become unmanageably hot or not. If to this we add (1) that the coal gets more broken the further it falls; (2) that the greater the cargo the greater the heap of smalls and dust; we shall be prepared to consider a small increase in the depth of hold as a phenomenon of the first importance in relation to the question of the heating of cargoes."

They also expressed their belief that there was no case on record of a cargo of coal taking fire anywhere except under the square of one of the hatches, and stated that that hatchway generally, if not always, was the main hatch.

In conclusion, they recommended that very large ships should not be loaded with the existing appliances when the maximum shade temperature rose above 80° Fahr., or the maximum sun temperature rose above 110° Fahr.; and concurred in the views of the Royal Commission of 1876 regarding through and surface ventilation.

With regard to the loading of ships when the thermometer records a high temperature, through the kindness of the Secretary of Lloyd's I hold in my hand a list of ten British and foreign sailing vessels that were loaded with coal at ports in the United Kingdom during the hot weather of July and August of this year, all of which met with misfortune in a greater or less degree owing to spontaneous combustion or heating. Their respective depths of hold were 24′·4, 24′·2, 21′·3, 19′·1, 22′·5, 22′, 22′·9, 22′·2, 24′·4, and 22′·7, but, of course, I am unable to say what was the depth of the coal in each vessel when their loading was completed.

Professor Mas, an American expert, in discussing the causes of fires that have taken place in the bunkers of vessels belonging to the United States Navy, says:—"It is not so much the composition of the coal which is responsible for these cases of spontaneous combustion, as it is

the heat caused by the enormous weight and corresponding pressure on the lower *strata* in a bunker of, for instance, a capacity of 1,000 tons." He evidently lays stress upon the height, as without a certain height there would be but little pressure, but, at the same time, he in no way gives any indication of what, in his opinion, the critical height may be. He goes on to say that "Almost any kind of coal, if crushed, and heaped up and moistened, will gradually develop an intense heat, and when the proportion of sulphur adds to the inflammability, anything short of anthracite might ignite." However, I will not follow him further, except to say that in another place he ascribes some fires to friction caused by the rolling of the vessel.

I am informed that underwriters, when insuring vessels carrying New South Wales coal, now insert a clause declaring the policy null and void in the event of the coal exceeding a depth of 14 feet.

While upon the exceedingly interesting point that the height or the depth of a heap or a cargo of coal has a very important bearing upon its liability to spontaneous combustion, the fires that have from time to time broken out among the coal stored at Portsmouth for the use of the Fleet will probably recur to our recollection, and the question naturally suggests itself as to whether those fires may not in some way be traced to the stacks having been above a certain height. At any rate, the matter is one for consideration.

On 11th May, 1897, the Governor of New South Wales appointed another Royal Commission to make further investigations into the causes of the dangers to which vessels carrying coal are liable, and its report was presented on 27th March, 1900. The Royal Commissioners originally consisted of Professor Threlfall and Mr. Pitman; but the latter having resigned, his place was taken by Mr. Arthur Ernest Savage.

The Commissioners conducted a very important experiment during the Australian summer of 1898-99, under an air temperature of from 70° to 80° Fahr., with a view to testing the relative liability of dry coal and wet coal to spontaneous heating. Two wooden bins, cubical in shape, properly protected, and measuring about 21 feet on each side, were constructed. One bin was filled with 245½ tons of air-dry small coal of a bituminous description, suitable for household purposes, or gas or coke making, which was dropped in as it came to hand. The other bin was filled with 245½ tons of identical coal thoroughly saturated with water. Thirteen temperature tubes were inserted in each bin, and thermometer readings at different levels were obtained, 156 observations being taken daily. On 10th December, 1898, the mean temperature of the dry bin was 39·8° C., and that of the wet one 28·9° C. On 13th February, 1899, the temperature in the central tube of the dry bin, about 8 feet from the surface, was so high that the solder connections of the thermometer were

melted, the string used for raising and lowering it became charred, and the instrument was lost. The dry bin was then flooded to prevent damage. On the other hand, the maximum temperature observed in the wet bin was 48° C. at 6 feet from the surface on 18th January, and it afterwards decreased. The mean temperature of the wet coal did not rise above about 35° C.

In the result, the Commissioners came to the conclusion that "Coal is less liable to spontaneous combustion when it is loaded wet than when it is loaded dry," and that if "ordinary New South Wales Newcastle coal be loaded wet, the chance of its becoming heated during a voyage of eighty days through any ordinary weather is almost vanishingly remote." They also drew attention to the fact, as shown by the experiment, of "how very much coal is cooled by wetting it thoroughly with water, which itself is not very much cooler than the air."

Continuing, they said that the conclusion they had arrived at with regard to the carriage of wet coal and of dry coal could, of course, only refer to the description of coal they had used; but that there was reason to believe that it would apply to all coals not containing a great excess of pyrites, and very possibly to them as well. "The truth is, that the idea that wet coal is more likely to heat than dry coal does not rest on any direct or scientific evidence. Instances brought under the notice of the former commission on coal cargoes broke down on cross-examination, or were otherwise explained. In 1876 the English Commission on the heating of coal cargoes asked the question as to whether wet coal was or was not more liable to heating than dry coal, and received twenty-six answers to the effect that wet coal was the more dangerous. An analysis of the evidence, however, discloses that twenty-five of these answers were based on "general impression" or heresay evidence only, while the twenty-sixth was not tested by cross-examination. The opinions referred to were held, not by scientific men, but by those engaged in the coal trade, and concurrently with the idea that heating was due to a sort of fermentation in the coal similar to that which takes place in hay, in which case, of course, moisture plays a very important part. All such views, it seems to us, must now be definitely abandoned, nor is there any chemical or physical reason for thinking that salt water would be more likely to promote heating than fresh water, but quite the reverse."

The Commissioners recommended that "When large ships are being loaded during warm weather (say, when the air temperature is 90° Fahr. or over) a hose should be played down the hatchway so as to wet, at all events, the coal which collects at that spot."

In July of last year, an inquiry was held at Cardiff by Captain Castle and Professor Threlfall into the circumstances attending the serious fire-

damage sustained by a sailing ship named the "Walter H. Wilson," while on a voyage from Cardiff to Coquimbo.

This ship was of 2,518 tons gross register, and sailed on 2nd October, 1899, with a cargo consisting of 857 tons of coal, 2,120 tons of coke, 480 tons of bricks, 13 tons of fire-clay, 10 tons of iron, 50 cases of dynamite, and 1 case of detonators.

The coal was loaded between 25th August and 5th September, the first 200 tons being perfectly dry, while the remainder was estimated to contain about 100 tons of wet coal, which was more or less mixed with the dry coal, the first shipment being, of course, underneath. The coal, which was a bituminous one, had passed through a screen with bars 1½ inches apart, and contained much fine dust. It was stowed in the lower hold, and was covered with coke right up to the main deck, the total depth being about 20 feet.

The report says:—"The layer of coke placed above the coal would operate in a manner very favourable for the initiation of a spontaneous fire, for it is sufficiently porous to allow of the necessary small air supply to the coal, and at the same time acts as a good heat-insulating material, and prevents the heat generated from passing away."

On 14th October there was a slight smell of sulphur observed, which passed off. On the following day the same thing occurred again, but there was no smoke nor steam visible, and the master and chief mate were of opinion that the odour proceeded from the coke. There were no temperature tubes in the cargo, but the temperature was taken in the pump well and hatchways. On 8th November smoke of a pale colour was observed coming up through the hatchways, the thermometer showing 82°. The smoke came up first from one hatchway and then shifted to another, and the master located the fire as being between No. 1 and No. 3 holds. On 13th November some of the coke was jettisoned, but the master of a steamer that had arrived on the scene thought that the vessel would be all right, and advised that it would be better to keep all the hatches on. The thermometer at this time had risen to 88°, and the mizzen-mast was found to be hot. The dynamite and detonators were then thrown overboard, a hole was cut in the deck near the mizzen-mast, and water was pumped into the hold. On the same day the ship was taken in tow by the s.s. "Newton," and arrived at Bahia on the 15th. The fire was apparently got under, but it broke out again upon several occasions, and caused great difficulty in discharging. The incubation period of the fire was between 75 and 65 days, and the inspectors stated that "the average time is generally considered to be about 60 days for coal loaded under English weather conditions."

They also said:—"If two or three temperature tubes had been inserted in the coal, there is no doubt that the heating would have been

discovered in time for its further progress to have been averted by digging some of the coke out and pouring water on to the coal. It is very much easier to do this before an actual fire occurs, for as soon as the coal gets anything like red-hot the heated zone becomes armoured over by a practically impervious skin of coke and coal and the products of the distillation of coal, and there is also very possibly an appreciable gas pressure to be overcome. Water poured on to the top of coal can only filter through comparatively slowly, especially if the coal be 'small,' and it is thus difficult to get it to the seat of the fire in sufficient quantity to be of any use. It is obviously difficult for men to face the smoke and gas in the confined space of a hold so as to dig reasonably close to the centre of combustion."

With regard to a fire armouring itself over, as mentioned in this report of the "Walter H. Wilson" inquiry, instances have occurred where spontaneous combustion having taken place, the armouring process has developed itself, and the fire has burnt out, leaving a large hollow cone which was discovered when discharging the cargo.

Professor Threlfall alone answered certain questions submitted by the Board of Trade, and in doing so naturally followed the lines of the Reports of the New South Wales Royal Commissions, although in one or two directions his remarks appeared to be rather more pronounced.

He said that, with regard to pyrites, a very strong case could be made out against the theory that it is in general an active cause in initiating spontaneous combustion; and that, so far as he was aware, no single case of spontaneous combustion, either on land or on sea, had been shown to be due to the presence of pyrites in coal. This, it will be observed, is in direct conflict with the information quoted from "Chambers' Encyclopædia."

In support of his position he continued:—"It has been argued that though pyrites itself may not directly cause spontaneous combustion, yet, nevertheless, it may assist in breaking up the coal into smaller fragments, and thus indirectly act as a favouring cause. This argument is, however, of no avail, for:—1. It has been stated that the process of the weathering of pyrites takes in general much longer than the process of spontaneous heating of coal. 2. In all known cases of spontaneous heating of ordinary whole or large coal at sea the fire has originated in the heap of dust and small coal under the hatchways. In these heaps the coal is already in such small fragments that any further breaking up, such as could be produced by pyrites, can have no influence on the result. As a matter of fact, pyrites does not on weathering break up the coal into anything like such fine dust as normally penetrates the heap under a hatchway. . . . . The conclusion arrived at from the foregoing considerations is that for all practical purposes pyrites is not an agent either direct or indirect in the spontaneous heating of coal."

"The conditions which lead to a spontaneous fire are clearly conditions requiring some nicety of adjustment. Oxygen must be supplied to just the required extent, the heat generated must not be carried off too freely, and the increase of ventilation due to heating must not be too great.

"This is the explanation of why some cargoes fire, and others, loaded as nearly as can be judged under identical conditions with the same coal, and making the same voyage, escape.

"A slightly higher initial temperature, a slightly increased breakage, a slight difference in the friability of the coal or its condition as to porosity, or in the nature or amount of its bituminous constituents, may make all the difference between a safe voyage and a total loss, and therefore some ships will be taken and others left apparently capriciously (but not really so), just as we find is actually the case.

"A heap of coal broken into small pieces and the interstices filled with dust will, generally speaking, be in a condition highly favourable for a spontaneous fire. But there must be the right quantity of dust, and it must be of the right fineness, or no fire will occur."

The learned professor thus summed up :—

"In the case of cargoes of large coal, the only danger is in the heap of small coal under the hatchways. . . . .

"It follows, therefore, that if the coal under the hatchways is thoroughly wetted, the danger of spontaneous combustion will be avoided. In the case of small coal, such as that loaded on the 'Walter H. Wilson,' the whole mass of the coal should be thoroughly wetted either before or during loading.

"If this were done, the coal could be loaded safely, and it would not be necessary to employ temperature tubes.

"The coal may be wetted either by salt or fresh water—it does not matter which, but it is an advantage to have the water as cold as possible, so as to cool the coal to the lowest practicable point."

Captain C. P. Wilson, Principal Officer of the Board of Trade in London, has very kindly shown me certain temperature records and other papers (which I have condensed) from which the opinion that wet coal is less liable to become heated than is dry coal has recently received a very practical confirmation.

The sailing-ship "Strathdon," 2,093 tons gross register, left Newcastle, N.S.W., with a cargo of coal, on 16th June, 1900, under the command of Mr. A. Walker, bound to San Francisco. It had rained very hard for several days during the time that part of her cargo was above ground awaiting shipment, and consequently that portion became thoroughly wet—indeed so much so, that the water ran out of the trucks as it was being put on board. The other portion of the cargo was

perfectly dry. The dry coal was placed in No. 1 and No. 4 holds (situated respectively at the forward and after ends of the vessel), while the wet coal was placed in No. 2 and No. 3 holds. The holds are 23·6 feet deep, temperature tubes 22 feet long were inserted into the body of the cargo down each hatchway, and the temperatures were regularly taken and recorded in the log-book. Surface ventilation was provided by means of cowls, and the hatches were off during nearly the whole of the voyage. The air temperature was about 62° at the port of shipment, 92° on the Equator, and about 72° at the port of discharge. The difference between the temperatures of the wet and the dry coal was very marked to begin with, they being respectively 62° and 74°, or, in other words, the wet coal was 12° cooler than the dry coal. The temperatures in No. 1 and No. 4 holds, wherein was the dry coal, rose gradually from 74° to 94° and 92° respectively; and in No. 2 and No. 3 holds, wherein was the wet coal, the temperature rose slowly to 77° by shortly after the fortieth day, remained steady for some time, and then fell back 2° during the remainder of the passage. Upon arrival at San Francisco on 25th August, No. 1 and No. 4 holds were respectively 94° and 84°, and No. 2 and No. 3 holds were respectively 74° and 75°. The maximum difference between the wet and dry coal during the voyage appears to have been 22°. The mean of the temperatures taken in No. 1 hold during the passage was 85·9°; in No. 4 hold, 82°; in No. 2 hold, 69·7°; and in No. 3 hold, 70·5°; showing a mean temperature of 13 8° in favour of the wet coal—that is, the wet coal was 13·8° lower.

It is of some interest to remember that the "bin" experiments of the New South Wales Royal Commission were made during the Australian summer, while the loading of the "Strathdon" took place during the Australian winter.

The statement contained in the report of the first New South Wales Royal Commission that "The moderate warming of the coal by a steam pipe or boiler may enormously shorten the time necessary for spontaneous combustion to set in, or may render spontaneous combustion possible in cases where it would otherwise be impossible," is confirmed by a case that came to my notice a short time ago. The bunkers of a certain steamer were constantly catching fire, and so it was determined to insulate them from the heat of the stokehold; and that having been done by means of some sort of lagging, the trouble on this head became a thing of the past.

With regard to the danger attending the through ventilation of coal, reference may be made to a source of risk that arises from mast ventilators, for should any openings below the level of the top of the cargo not be properly closed, a dangerous species of through ventilation will exist wholly unsuspected.

By American law, all passenger steamers crossing the Atlantic to or from ports in the United States are required to be able in case of necessity to inject steam into their holds, and there is no reason, except the cost of piping, why even sailing-vessels provided with donkey boilers should not adopt a similar system. At the same time, it must be remembered, that neither water nor steam is an altogether satisfactory agent for extinguishing fire on board of coal-laden vessels—the former, owing to the obvious difficulty experienced in getting it to the source of the mischief, and the latter, owing to the fact that it would hardly permeate a mass of coal, and could only act as a species of wet blanket.

As a matter of fact, when fire has once broken out among coal on board ship the question of how best to deal with it is a difficult one, for the method that may be effective in one case may be disastrous in another. Indeed, it may be said that in some respects the person responsible occupies much the same position as did the mariners of old with regard to Scylla and Charybdis, and is, in other words, between the devil and the deep sea.

As an instance of this, I may mention that in 1870 the ship "Compeer," bound to Bombay with 1,400 tons of coal from Greenock, spontaneously caught fire in her hold when she was 80 days out and about 300 miles from the Maldive Islands. An attempt was made to dig out some of the coal in order to get the 'tween deck hatches on, with a view to smothering the fire, but the fumes exhaled soon drove the men from their work. The upper deck hatches were then put on and battened down. Before much time had elapsed, a terrific explosion took place, doing great damage to the ship, which was totally destroyed by fire in the course of a few hours. Upon being conveyed to Calcutta by a vessel that was in company at the time of the casualty, the master (Mr. J. Monro Reid) found that a ship laden with English coal, which had been on fire, had arrived during the previous week. In that case, identical measures had met with success, and no doubt that was due to a difference in the gaseous nature of the two different descriptions of coal, and also to other non-identical conditions.

Although it has been fully demonstrated that wet coal is safer to carry than dry coal, we are brought face to face with some practical difficulties.

In the first place, it is almost needless to say that shipowners conduct their business with a view to getting a return upon the capital invested in the vessels under their management, and the carrying capacity of those vessels is limited among other things by their load-lines; accordingly, they can hardly be expected, in these days of keen competition when there is frequently but little margin between a profit and a loss, to look with any great favour upon a proposition that they should transport about the world many tons of water, upon which they would receive no freight, to the exclusion of paying cargo.

Of course this objection only holds good in a minor degree as regards the wetting of heaps of small coal collected under the hatchways, and, looking at the value of the lives and property at stake, this plan might well be adopted, or, at any rate, be given a fair trial.

At the same time, the consignees having purchased what is generally known as dry coal—air-dried coal contains usually from 3 to 10 per cent. of moisture, although some bituminous Pennsylvanian coal has been found to contain as much as 15 per cent.—might probably object to take delivery of wet coal.

In the case of the "Strathdon," her master stated that at the end of the voyage there was practically no difference in the general appearance of the two descriptions of coal, that is between the wet and the dry; and, from what has gone before, there is little reason to suppose that the practice of wetting coal would in any way alter its ultimate character and so depreciate its market value; but all the same it must be remembered that prejudices die hard, and no less hard in the commercial world than elsewhere.

Again, the effect upon the structure of the hull of carrying a large wet mass confined in the holds of an iron or steel sailing ship for some months (particularly when passing through the tropics), or in the warm bunkers of a steamer, will require careful consideration.

Whether wet coal or dry coal is carried, it would be of great interest and value in connection with this important subject if a regular uniform method of taking temperatures daily and recording them were adopted; and perhaps the Board of Trade may see its way clear to make such a recommendation and to issue the necessary forms.

This was as far as I had originally intended to carry my paper, but rather more than a fortnight ago, when in pursuit of information with regard to coal-laden vessels, I by the merest chance heard of an invention for preventing or extinguishing fires by means of sulphur-dioxide gas. Accordingly, I made inquiries, and last Friday week, through the courtesy of the directors of the Clayton Fire Extinguishing and Ventilating Company, I was enabled to witness some very instructive and to my mind exceedingly valuable experiments with the apparatus.

To roughly and briefly describe the machine used: it consists of a gas generator, placed above what is known as a cooler (the function of which will presently appear), with a small engine alongside it to work the blower which delivers the gas through a pipe to the place where it is required, the whole being very compact and suitable for the limited space available on board ship. The pipe service to the desired compartment is double, the one being a delivery pipe and the other a return pipe. The operation is commenced by throwing a little burning cotton waste saturated with spirits of wine into the generator, where stick sulphur is used, and the

necessary atmospheric air is supplied through a valve. The sulphur soon ignites, the door is closed, the generation of gas commences, and the blower is set to work to deliver it.

When from 5 per cent. to 10 per cent of the atmospheric contents of the compartment treated consists of the sulphur-dioxide gas (SO_2)—and the amount is readily ascertained by the use of an ingenious instrument called a burette—it is claimed that the fire will be out, even though it had been burning ever so fiercely, that all danger will be over, and that the process of generation can be discontinued.

An objection raised by the Royal Commissioners of 1876 to the use of carbonic acid gas was that it exercised no cooling effect, and we shall now see how the cooler (already mentioned) below the generator comes into play. The generator is cut out of the circuit, and the hot air is drawn out of the compartment and passed through a number of tubes contained in the cooler, the tubes being surrounded by constantly changing water. This cooled air, which of course contains its due percentage of sulphur-dioxide gas, is re-injected into the compartment, and so the process goes on, and can be continued until all the air in the division has been brought down to about the level of the temperature of the water in which the ship may be floating at the time. During the generation and delivery of the gas, under ordinary circumstances the necessary air can be drawn from the compartment, but for obvious reasons it is not advisable to do this in the case of coal cargoes.

It is claimed that as soon as a ship has been loaded, her hatches may be safely battened down, so long as 5 per cent. of the sulphur-dioxide gas has afterwards been injected into the hold, and that an explosion of coal gas under these conditions is an impossibility.

As we know, coal gas gives no indication of its presence until perhaps someone approaches it with a light, and then an explosion occurs; and carbonic acid gas may be wholly unsuspected until those entering its embraces fall senseless; but notwithstanding that sulphur-dioxide gas too is fatal to life, I can vouch from personal experience that no person possessed of a nose can be unaware of its vicinity.

Moreover, although it is so pungent, although its power of putting out fire is so great—Professor A. L. Metz, Chemist of the City of New Orleans, etc., estimates it as being upwards of three times that of carbonic acid gas—and although its penetrative power is so intense—it is said to have permeated a bale of heavily pressed cotton—it is readily dispersed, and does not hurt any description of dry goods, even such a delicate article as tea having safely passed through the ordeal.

When I visited the experimental chamber at Blackwall—a brick building measuring about $16' \times 10' \times 9'$, specially fitted with holes for

purposes of experiment covered with iron caps, and peep-holes covered with mica—I witnessed the following experiments :—

a. A lighted torch was thrust into the chamber, and it was instantly extinguished.

b. A long lighted torch was slowly inserted in the chamber, and as it entered the fire was extinguished at the same rate of progression.

c. A broad red-hot bar of iron was inserted in the chamber, and a torch composed of straw dipped in naphtha was then placed upon the iron, but neither the naphtha nor the straw ignited.

d. A broad red-hot bar of iron was inserted in the chamber and thrust into a bucket of naphtha, the result being similar to that of placing a red-hot iron in a bucket of water.

The chamber, which at the commencement of the experiments had contained about 6 per cent. of sulphur-dioxide gas, was now opened, and after the gas had been dispersed, a bonfire, consisting of wood, straw, and other inflammable articles, over which a bucketful of naphtha had been thrown, was lit and allowed to burn freely, the door was closed and the generator was started. In a very short time the fire was a thing of the past, although the wood continued to crackle from the effect of the excessive heat to which it had been subjected. At this time there was about 8 or 9 per cent. of sulphur-dioxide gas in the chamber.

After this, I was shown the cooling apparatus at work.

In conclusion, I returned home with the conviction, acquired from the reports with which I had been furnished, and from what I had personally seen, that Mr. Thomas Clayton, the inventor of the apparatus I have described, has effectually solved the very difficult problem of how to carry even the most fiery and inflammable descriptions of coal on board ship, on long voyages, with complete immunity from danger; and I thought that the description of his method, which I have just given, might prove of peculiar interest to the members of this Institution, which has done, and is doing, so much to advance naval and military science and art.

Mr. THOMAS A. EVANS (of the Clayton Company, London) :—I should like to refer to one or two points that Commander Caborne has touched upon in his most interesting paper. I have listened to that paper with very great interest. He has pointed out that the spontaneous combustion of coal is due to its property of absorbing oxygen, the absorption of oxygen causing the generation of heat, and as the heat increases so does the power of the coal to absorb oxygen increase; and that, I take it, is the cause of spontaneous combustion. In the case of the carriage of coal at sea, the atmosphere surrounding the coal consists roughly of twenty per cent. of oxygen and eighty per cent. of nitrogen, an atmosphere conducive to spontaneous combustion. Now, if that atmosphere be changed to one containing five per cent. of sulphur-dioxide, fifteen per cent. of oxygen, and

eighty per cent. of nitrogen, still speaking in round figures, an atmosphere is produced which not only does not support combustion, but in which the inception of combustion is impossible. It is with such an atmosphere that it is proposed to surround the coal in transit on board ship by the Clayton process and to keep it so surrounded, under which conditions, I submit, the safe carriage of coal is practically reduced to a certainty. Why the five per cent. of sulphur-dioxide should have the effect of converting an atmosphere containing at the same time fifteen per cent. of oxygen and eighty per cent. of nitrogen, into one which will not support combustion, I do not pretend to explain: but I can speak from my own observation that this is the case, and I have in my hand a letter from a very famous professor of chemistry confirming that opinion. With regard to the sulphur-dioxide gas permeating a cargo of coal or a bale of cotton, we have proved over and over again that sulphur-dioxide gas will enter right into the centre of a bale of cotton. The way we introduce the gas into a ship is by a system of pipes. I think I showed Commander Caborne the other day a plan we had drawn up for a steamer to introduce the gas throughout the vessel's hold. We introduce the gas into the bottom of the hold with a discharge pipe and force it in with a blower working under a certain pressure. That ensures the gas permeating throughout the hold. We have carried out some fumigating work in London recently with sulphur-dioxide on board B.I steamers and others, and one of the chief features of our system is that by the forcing of this gas into the vessel's hold it penetrates every nook and corner, and not only kills all vermin and rats but thoroughly disinfects the ship from stem to stern. I have particulars, and should anyone require to have them I shall be only too pleased to give them. I have here an instrument by which we record the percentage of gas in the atmosphere. We pass the atmosphere, in which there is a certain proportion of sulphur-dioxide gas, through this glass cylinder, and then close the cocks, so that we have a sample of the atmosphere which we wish to test. We fill the top part or cup of the cylinder with water, and as water absorbs sulphur-dioxide gas without increasing its bulk, when we turn the top cock slowly the water will fall into the cylinder and be absorbed by as much sulphur-dioxide gas as is there present. The cylinder is marked with one hundred equal graduations, and if the water rises to, say, ten, eleven, or twelve graduations, you have that percentage of sulphur-dioxide in the atmosphere tested. (Mr. Evans then practically illustrated the use of the tube, known as a Burette.)

Mr. JOHN D. MOORE (of the American Clayton Company):—Before describing an experiment which we had the pleasure of performing in New York for a commission appointed by the United States Navy Department to enquire into the system to which Commander Caborne has referred in his paper, I might lay especial stress upon one point Mr. Evans touched upon, and that is the positive property which sulphur-dioxide gas has of conquering and subduing fire by virtue of what is apparently an inherent property. At first sight it might appear that the extinction of fire was merely a problem of attenuation or vitiation of the atmosphere: that is to say, if we infuse into any compartment in which fire is burning an inert gas which would diminish the percentage of oxygen, one would consider, at first, that one gas would serve as well as another. We have performed experiments in our laboratory in the United States, using as our three trial gases, carbonic acid gas (which has been always considered the ideal fire-extinguishing gas), nitrogen, and our own sulphur-dioxide, and we found we could subdue fire with one-fifth of the nitrogen required, and with one-third of the carbonic acid gas required; in other words, sulphur-dioxide is three to five times as powerful as the other inert gases.

The CHAIRMAN :—I understand that it will permeate coal, but I believe Mr. Evans said that it required a ship to be specially fitted for its use.

Mr. MOORE :—Yes, the ship should be specially fitted. To that I will refer in a moment. Our experiments in New York, as prescribed by the naval officers detailed to examine the apparatus, consisted of filling the chamber with about 15 tons of coal piled to a depth of 6 feet, which was ignited and set into active combustion by means of a blower, the blast being distributed through perforated pipes at the base of the coal. After pumping for several hours, we succeeded in getting this 15 tons of coal so hot that the fire not only burst through the surface, but vitrified fire-brick and concrete, and melted portions of the coke at the bottom into the concrete floor of the basin. We then generated the sulphur-dioxide gas, pumped it in through the perforated pipes, and circulated it, and in the morning on opening the compartment the coal was found to be extinguished : all combustion had disappeared, and the coke had so cooled down that it was quite possible to take it in the hands. We found that certain portions of our pipes had been welded to the floor, but, nevertheless the entire mass of coal had been so reduced in temperature that the remotest trace of fire had disappeared. With regard to applying it to a ship, we are satisfied from our experiments, and from the conversations we have had with the American mining operators, that the main danger we shall have to guard against is the clogging of the perforations in the pipes. We have endeavoured to invent, and we think we have invented in America, a kind of protected or hooded conductor which will have the effect of securing our conductors against the clogging with the fine coal-dust which is bound to percolate through as the cargo is stowed. We think the distribution of the gas in the cargo is possible with our blower, but we attach more importance to the prevention of fire than we do to its extinction, because prevention is better than cure. If we can prevent the oxidation which everybody acknowledges now is at the root of spontaneous combustion by means of vitiating the atmosphere with sulphur-dioxide, the problem has been solved in its very inception.

Mr. W. E. STANLEY THOMSON :—About eleven years ago we had in this room an extremely interesting lecture by Professor Vivian B. Lewes on "Spontaneous Combustion in Coal" (JOURNAL, Vol. XXXIV., No. 154), and he treated his subject from every point of view that we have had before us this afternoon, more especially with regard to pyrites. Now, Commander Caborne has given us many useful extracts from the Report of the Commission of 1876, and has told us of the importance they attached to the presence of pyrites, also of wet coal, in preventing spontaneous combustion : but he has omitted to tell us about Professor Lewes' chemical experiments in 1890, by which he proved most conclusively that pyrites was an overrated danger, and that as a fact it contributed only in an infinitesimal degree to the heating and possible firing of coal. The New South Wales Commissions have, it seems, also speculated in the same direction in 1896-7, and it is satisfactory to find their conclusions so strong as to amount to corroboration, and proof positive that pyrites is practically harmless. But we are also indebted to Professor Lewes for an analysis of coal, with a view to testing the theory as to its absorption of oxygen, and here again we find the New South Wales Commission in agreement with him, and having arrived at that stage of agreement, the wonder is that the Commission have not still further discussed his theory that for shipping purposes there need practically be no anxiety about this absorption of oxygen, except it is at a time when the coal is in its most receptive condition, namely, when "green" and newly won from the pit. I mention this, not merely because I think that Professor Lewes ought to have credit for what is due to him, but because we learn more

from cumulative experiences and research than from that sort of independent enquiry which overlooks former enquiry, and it is of consequence to have all possible information before us informing or changing our views on this or any other scientific question. Our attention, however, is drawn to a new phase of the question. The underwriters in New South Wales refuse to insure ships that are carrying coal to a depth of more than 14 feet. But why? I gather from Commander Caborne that it is because depth means weight, and that weight pulverises, and produces a condition which renders the coal liable to ignite by spontaneous combustion. But if this is so, it is strange that modern ships, of two or three thousand tons burden, employed in the coal trade, *viâ* Cape Town, fire so seldom. Moreover, we should expect to hear more frequently of fires among the huge heaps of coal stored at our great factories. The Commission in 1876, it is true, found that fire was more frequent with vessels of large than with small tonnage, but their understanding of the cause was not that of pulverisation, but of through ventilation and the presence of other contributing causes. In these circumstances it seems to me that the New South Wales underwriters are hardly acting on any very reasonable grounds. But Commander Caborne discusses a much more important question in dealing with the risks attending putting on board coal in a wet condition. He quotes the Commission of 1876, the New South Wales Commission, and the more recent enquiry into the firing of the "Walter H. Wilson," and the conclusion he seems to draw is, that wet coal is a positive advantage rather than a danger on board. Now, as it has hitherto been customary to act on a contrary opinion, it is as well to see whether Commander Caborne or the Courts of Inquiry are right in their premises. And, first, it should be noticed that Commander Caborne pins his faith on an experiment in New South Wales with wet and dry coal in large quantities, in two bins side by side and under cover of a shed. By testing the temperature frequently it was ascertained that the dry coal heated rapidly, and that the wet coal having got to a moderately high degree, the temperature actually receded slightly and so remained, while the dry coal heated until it reached such a temperature that it became necessary to shift it to avoid its firing. It must be noted, however, that these were not conditions corresponding to coal on board ship on a very long voyage. The bins were not air-tight, as they were made of loosely fitting boards; nor were they closed in at the top, being in an open shed; while on board ship the coal would have been under hatches, subject to heat from the engine-room, which would be accelerated in passing through the tropics. This test, therefore, is by no means satisfactory for our purposes. But again, as regards wetting the coal. The Commissioners in 1876 no doubt dwelt more particularly on their impression that moisture or even a thorough wetting of the coal would contribute to decompose nodules of pyrites and so promote spontaneous combustion; nevertheless, they also considered that coal generally, regardless of pyrites, "should be kept as dry as possible." Several witnesses before them had, the Commissioners said, urged that wet coal was a real danger, and one witness, Mr. Newton, in answer to question 553, gave as an instance in his own actual experience that while shipping a cargo of 1,500 tons of coal from lighters it rained in torrents, so that when put into the hold, the cargo was "thoroughly saturated." Nevertheless, three months afterwards they had to abandon the ship on fire from spontaneous combustion. Professor Lewes, too, speaking at a meeting of the Society of Arts (*Journal*, March, 1892, page 356), said:—"During last autumn a very marked case of the influence of moisture, as affecting the chemical action which he had described, came under his notice. A ship took in cargo at a South Wales port, the weather being fine and dry while she was loading at the main hatch, and wet whilst taking in the coal at the after hatch, with

the result that the temperature after the first few days was uniformly about 10° higher in the coal that had been loaded wet than in the dry portion of the cargo, spontaneous ignition being the ultimate result." It is quite possible that the risk as regards wet coal lies in the probability of its caking the "small," and so filling the interstices between the lumps and preventing any cool air percolating from the surface, while, underneath, powdered coal, well oxidated when put on board, has been generating spontaneous combustion with the aid of air received somehow from below, coupled with heat from the engine-room. But is not this the simple process which we can any of us witness at the blacksmith's forge? Does he not thoroughly wet his surface coal, and by so doing, cakes it so that on using his bellows he pumps oxygen into the almost dead embers and so produces a fierce low fire which will very soon make red hot the bar of iron which he thrusts in for the purpose? In view of these illustrations, I am afraid I cannot agree with Commander Caborne's deductions, and I am still conservative enough to believe that wet coal is more or less of a danger, and that great care ought to be exercised so as to avoid putting it on board for a long voyage. As regards taking the temperature on board, this has always been urged as a desirable course, but it is seldom done systematically, and very often in the most perfunctory manner. Moreover, we have had cases showing that the results are often erratic and very undependable, inasmuch as a cargo may be burning fiercely at the bottom, and yet a few feet down from the surface the coal temperature, as shown by the thermometer, is apparently unaffected by what is going on beneath it. At the close of his paper, Commander Caborne very justly speaks in commendation of the Clayton Fire Extinguishing Apparatus. Professor Lewes' idea was to use carbon-dioxide as a means of extinguishing fire in coal cargoes, but his idea has not taken on; and now we have a new suggestion in the use of sulphur-dioxide. I should, however, like to ask Messrs. Clayton how that gas can possibly be made to penetrate to the bottom of a ship's hold through an enormous, densely packed mass of coal. Although in these observations, I have been perhaps unkindly critical, I must express the pleasure I have experienced in listening to Commander Caborne's extremely useful and valuable paper.

Captain J. D. CURTIS, R.N. (Retired):—I have had a little experience at Rio de Janeiro in surveying two coal-laden vessels, and one was on a vessel loaded with smelting coal going round the Horn to South America. The captain complained of his men being suffocated in the forecastle, and that is one of the points that I think ought to be mentioned, namely, that all the living apartments should be strictly protected from gas which may emanate from the coal. I do not know whether the men were suffering from carbonic acid gas, which is about the heaviest gas we have, but I should think it was more likely they were suffering from sulphuretted hydrogen, the product of the decomposition of the pyrites in the hold. I have always supposed that decomposition is more or less responsible for fires. The decomposition of iron is oxidation, slow combustion, and the decomposition of pyrites is slow combustion, sulphur ignites at a comparatively low temperature. Coal is nothing more or less than compressed vegetation. Haystacks occasionally take fire, and to avoid it they have to be ventilated. When the captain spoke to me I knew very little about the matter of coal-laden vessels, and I referred to the Admiralty instructions. I told the captain to keep his hatches off as much as possible in fine weather, and to put a cowl on similar to those put on malting-houses. I also told him to put an iron into the hold through the cargo, and by feeling the iron on the deck it would be possible for him to tell whether there was heat

below. The vessel was not actually on fire, but there was some heat in the coal However, she reached South America. I was also called upon to serve on another vessel belonging to the P. and O. Company. She was to be a coal vessel in Japan. The captain had his wife on board, and she was very much frightened because of a fire which occurred. The ship came into Rio, and though the fire was not bursting through the hatches, there was certainly a fire burning in the main hold. I think we surveyed that vessel three times, and the captain would insist on having the cargo discharged on shore. I was very much in favour of the cargo being reshipped, but the captain would not do that, and the vessel lay four months at Rio, and ultimately sailed in ballast; as you can imagine, at great expense to the P. and O. Company. With regard to the sulphur-dioxide, I believe it is rather rough on rats, is it not?

Commander CABORNE:—I think so!

Captain CURTIS:—I should like a little in my muffings in Norfolk. But it would be very rough, I think on the people in the ship if this sulphur-dioxide came into the cabins or into any inhabited part of the ship. If it could be used safely I suppose it would be a very good thing. In Vancouver, I saw a heap of sawdust 8 or 10 feet deep. It was on fire, and the sawmill people were trying to put it out. It was supposed to have taken fire by spontaneous combustion, probably due to its being composed largely of resinous matter. It is not an uncommon thing in the forepeak of a ship where oil and cotton waste and new tarpaulings have been stored to find a fire taking place. I was looking at Dr. Ure's Chemical Dictionary, and I find it there states that there was an official enquiry on board a man-of-war, where it was found that the fire took place from oil and waste being put in the forepeak. Possibly fire may be caused by the friction of the cargo caused by the motion of the vessel.

Commander WILSON-BARKER, R.N.R.:—I have to thank you, Sir, for permission to say a few words on Commander Caborne's useful and interesting paper. It is to be hoped that so thoughtful and painstaking an exposition of coal-carrying difficulties will receive the attention the subject deserves from men practically interested in it. My own belief is that combustion results from the presence of pyrites in the coal. A quantity of coal may be quite free from this agent, but one lump containing it, operated on by water and heat, will suffice to cause a conflagration. Commander Caborne clearly explains the different methods of dealing with coal cargoes. He seems to favour the wet process. I, myself, favour the exclusion of air, believing greater safety will be found thereby than in ventilation or in damping. If carried thus, I think, it is immaterial whether the coal be put in dry or damp. This plan was adopted with the one coal cargo I have had to deal with, which was from Newcastle, N.S.W. to San Francisco. The result was entire success, and the coal was not hot when discharged. Had the damping process been employed, the cargo of 1,880 tons would have been reduced to 1,770 tons. Before a process entailing such loss in freight is advocated, its value should be unquestionable. I should like to know more of the condition of the bins spoken of. How were they ventilated? Were they open at the top? If so, evaporation from the wet coal would lower the temperature. The account of the use of sulphur-dioxide gas as a fire extinguisher is interesting. The whole subject deserves fresh searching inquiry. It would be interesting to know the effect on the cargo in the case of a coal-laden ship that has been sunk for some time. I congratulate Commander Caborne on his very successful paper.

Professor WYNDHAM DUNSTAN, F.R.S. (Director of the Scientific and Technical Department of the Imperial Institute):—I should like to make one or two remarks on

this paper, which is a valuable one, if only for the reason that Commander Caborne has drawn public attention, for the first time in this country, to the extremely valuable reports of the New South Wales Commissions. I do not think a better piece of applied scientific work has been done for a long time than that which is recorded in these reports. He has also drawn attention to a very important series of experiments conducted in France by M. Fayol. I have myself paid a good deal of attention directly or indirectly to this question, which I approached entirely from the scientific, not from the practical side. The problem is very far indeed from being completely solved. The real fundamental question has not been attacked. The question is: What is the actual substance in the coal which combines with the oxygen of the air and produces the rise in temperature? All we know is that we may put lignite at one end of the scale and anthracite at the other—lignite being extremely active, and the other hardly active at all in developing heat. But until we know the constituent or constituents in the coal which produces this effect, we shall not be able to satisfactorily settle the matter. That constituent, I need hardly say, is evidently not pyrites. It appears to me that the experiments of Threlfall and Fayol leave hardly any doubt that pyrites is very rarely, if ever, the originating cause of the spontaneous combustion of coal. At the same time, it must be borne in mind that there are pyrites and pyrites. Pyrites in large modular masses is very little affected by the air; but in a thin layer of the same material, which is essentially a bi-sulphide of iron, then it is quite possible that rapid oxidation may result, and if oxidation results there will be heating effect which may contribute towards the combustion. That is one of the matters which, I think, requires further enquiry; and I think the same remark applies to the question of water. There has been a good deal of misunderstanding with reference to the meaning of wet coal. The experiments seem to lead to this conclusion, that up to a certain point, moisture is effective in promoting what I consider to be the essential fundamental chemical change, which is the change between the oxygen of the air and some at present unknown constituent of the coal. It is highly probable that a certain amount of moisture does assist that change to take place, but, on the other hand, a thorough wetting of the coal is probably antagonistic to that action taking place. Another point arises, which was drawn attention to in the report of the English Commission of 1876, and it has been rather confused since that report was issued. There is some evidence which goes to show that water, not mere moisture, may possibly assist the decomposition of the pyrites, and, as I read the report of that Commission, it is to the effect that water may be objectionable in the case of coal containing pyrites, possibly pyrites in a particular condition, but that for ordinary coal containing little or no pyrites the practice of wetting it with water is to be recommended. That is a point which Commander Caborne has brought out very clearly in his paper. It appears to me that there are three points which are proved by the experiments of M. Fayol and the New South Wales Commission. One is, that if the coal is stacked to a height much greater than 10 or 12 feet there is considerable danger of spontaneous combustion taking place. This is doubtless due to the fact that with that amount of coal present there is a greater likelihood of the heat being confined; that is to say, you may get a considerable local rise of temperature. If the heap is smaller, there is not so much likelihood of heat accumulating. The other point which, I think, is brought out with great clearness is the influence of the initial temperature; it is evidently unsafe to ship coal that is at all hot. Thirdly, it seems perfectly clear that through ventilation ought to be avoided. I do not think, anyone reading the account of M. Fayol's and Professor Threlfall's experiments, can doubt that free admission of air may be a very considerable

danger. From what I have said, I hope it is clear that, in my view, the matter is still very far from settled, and that what is wanted is experimental investigation on the one or two special points I have indicated.

Commander CABORNE, in reply, said:—I had hoped that Professor Threlfall would have been present to-day, but, unfortunately, he had a prior engagement. However, in a letter expressing his regret he says:—"I wish you every success in your lecture. I am sure that the subject might be better understood than it appears to be. If I might venture to make a suggestion, it would be to ask you not to forget to mention what we owe to the researches of Henri Fayol, a man whose work was practically—I may say, entirely—unknown in this country until I had the good fortune to come across it. If it be not an impertinence, I should like it to be generally known that I have received the most willing assistance from everybody with whom I have had to deal in the matter. The Australian Commissions were appointed by the Hon. G. H. Reid, at one time Premier of New South Wales, and I think that his enlightened policy should be recognised, for such an enquiry is quite an undertaking for such a small country as New South Wales. I used to be told that the Board of Trade was slow and difficult to deal with. I should like to say that from the very first moment I have received every assistance from their officials, especially Captain Chalmers and Mr. Gough, and never wish to meet with more business-like people. I think those gentlemen know more about the subject than anyone I have met over it, and are as keen as possible to get the matter set right. I had no idea we were so well governed." Speaking for myself, I am glad that this paper has received a certain amount of criticism, for a paper that does not provoke criticism is not worth reading; and, accordingly, I am much indebted to the critics. Mr. Thomson took exception to the New South Wales "bin" experiment, upon the ground that the conditions were not altogether identical with those which would have prevailed on board ship; but, conceding that to have been the case, it must be remembered that both dry and wet coal in large quantities were similarly treated, and therefore it is difficult to understand why the conclusions arrived at by the Royal Commissioners should be invalidated on account of the objection raised. With regard to the depth of coal having an important bearing upon its liability to spontaneous combustion—a fact that seems to have been well established—I am more concerned with the existence of that phenomenon than with its cause, and, without attempting to lay down any law, it is interesting to note that the question is one which at the present time is exercising the minds of gas-engineers whose coal stacks have a tendency to fire. I may say that Professor Vivian Lewes, in a paper (mentioned by Mr. Thomson) read before the Society of Arts in 1892, expressed the opinion that the depth of coal in a properly built and fitted coal store should not exceed 8 feet, and should only be 6 feet when possible. As I understand the Report of the Royal Commission of 1876, although the through ventilation of coal cargoes was justly condemned, yet it was fully recognised by the Commissioners that the larger and deeper the holds of vessels became, the greater would be the breakage and poundage of coal, accompanied by an increased risk. Mr. Thomson remarked that it is a curious thing that large ships engaged in the coal trade to the Cape fire so seldom. Well, out of the ten vessels to which I alluded as having recently got into difficulties with coal cargoes, six of them were bound for Table Bay! I frankly admit, that Professor Lewes is strongly of opinion that coal should be shipped and kept as dry as possible, being also the exponent of the theory that "the higher the amount of moisture held by the coal after exposure for some time to dry air, the greater will be its power of absorption for oxygen, and therefore its liability to spontaneous heating and

ignition," and viewed in the light of the New South Wales experiment and the experience of the "Strathdon," the instance that he gave before the Society of Arts of the heating of the wet portion of a ship's cargo is very interesting. But we have very few particulars about that ship. We are not told that any portion of her cargo was saturated with water, but only that the weather was "fine and dry while she was loading at the main hatch, and wet whilst taking in cargo at the after hatch." It may have been, and, looking at the difficulty that sometimes arises in wetting coal, probably was, that only a portion of the cargo in the after hold got damped in this way, and I think Professor Threlfall has never held that mere damping would be any protection: while, on the other hand, Professor Wyndham Dunstan has told us that moisture, as opposed to water, might be harmful. In the case of the New South Wales experiment, and also in the case of the "Strathdon," we are assured that the coal was thoroughly saturated. Professor Threlfall does not recommend that the entire cargo of a ship should be saturated, except in the case of some small descriptions of coal, but only that the heaps of "smalls" under the hatchways should be so treated with either fresh or salt water. Mr. Thomson's reference to a blacksmith and his forge is interesting, although I do not draw the same conclusions from it that he does. No doubt the action of the blacksmith in throwing water upon the small coal covering the hidden fire, to an extent brings about the armouring process mentioned in the paper; then, the heat being unable readily to escape, the coal also being small and presenting a large surface for the absorption of oxygen, and a good supply of oxygen being pumped in by means of the bellows, a fierce fire is the result—and that is precisely what the blacksmith wants. However, in this instance the fire has been lit by the blacksmith among dry coal, and he has only wetted the outer surface; accordingly, I fail to see that it furnishes the slightest proof that spontaneous combustion is more likely to occur among wet coal than among dry coal. As regards the sulphur-dioxide gas, I do not think there would be any difficulty in arranging for its delivery to any required position. Commander Wilson-Barker expressed the opinion that the presence of pyrites is the actual cause of the spontaneous combustion of coal, and said that one piece of it would do the mischief. Now to quote from Professor Lewes:—"The earliest theory as to the spontaneous ignition of coal was, that it was due to the heat given out during the oxidation of pyrites (the disulphide of iron) into sulphates, and this idea has been adopted, and has held its own, in this country up to the present time [1892], although the researches of Dr. Richters, some twenty years ago [now some thirty years], clearly prove that the explanation was an erroneous one, and the late Dr. Percy, as early as 1864, pointed out that probably oxidation of the coal had a great deal to do with the action. . . . . In some of the coals most prone to spontaneous ignition, there is only 0·8 per cent. of pyrites, and if we imagine the whole of this to be easily oxidisible, and to be concentrated in one spot instead of being spread throughout the mass, and to be entirely oxidised in a few hours, the rise of temperature would only be a few degrees: whereas, under existing circumstances, it is manifest that practically no determinable increase can be generated by the action. . . . . The only way in which pyrites can assist spontaneous ignition is that when they oxidise they swell, and causes disintegration of the lumps of coal, so exposing fresh surfaces to absorb oxygen and afterwards carry on chemical action." Professor Threlfall seems to have dealt effectively with this question of disintegration by pyrites. Continuing, Professor Lewes said:—"The idea that the percentage of pyrites present is any indication of the liability to spontaneous combustion must be entirely discarded, as experiment shows that many coals poor in pyrites frequently ignite, while others rich in them are per-

fectly safe." It will thus be seen that in the view put forward by Commander Wilson-Barker he is not in accord with the opinion of Messrs. Richters, Percy, Fayol, Dunstan, Threlfall, and Lewes. Assuming, however, simply for the sake of argument, that Commander Wilson-Barker is right, it is strange that the one dangerous piece of pyrites should have such a strong affinity for hatchways in general and main hatchways in particular, the fires almost always, if not invariably, breaking out under the square of a hatch, and usually the main hatch. With regard to the battening down of coal cargos, advocated by Commander Wilson-Barker, Professor Lewes was in favour of that course, provided that the coal had been above ground for a month: that no accumulation of fine coal was permitted under the hatchways; that a small 2-inch tube was carried some 12 feet up from the hold for the escape of gas, and that the hold was otherwise air-tight; and that, when possible, the coal should be shipped dry, as external wet, by producing oxidation of the pyrites, causes disintegration. No doubt, theoretically, this plan would be excellent, but as most of the conditions are practically unattainable, I would prefer that someone other than myself should travel with coal closely battened down. He also recommended that small steel cylinders, containing liquid carbon dioxide, and closed by fusible plugs, should be placed at intervals throughout the cargo (one to about every eight tons), so that if heating took place the plugs would melt and the liquid would be rapidly converted into gas and cause intense cold, which, together with the liberated carbon-dioxide, would effectually prevent any ignition of the coal. Though no doubt effective, here again, commercial and practical difficulties stand in the way. With regard to the objections that have been raised to the New South Wales experiment, I will write to Professor Threfall and ask him to be good enough to furnish a reply that can be added to this discussion. In conclusion, I beg to thank you for the patience and kindness with which you have listened to me this afternoon.

The CHAIRMAN (Admiral the Hon. Sir E. R. Fremantle, G.C.B., C.M.G.):—I am sure you will all agree with me that we have had a most interesting and able lecture. I was asked a little while ago what qualification exactly Commander Caborne had for speaking on this subject, and I think the answer is quite clear: he does not pretend to have a very large personal experience, but he has been of very great service to us as a sensible and clever man in looking up all those blue-books and getting together a great deal of information, from which I am quite sure we shall all learn something, and seafaring men will learn a great deal. I do not wish to enter generally into the subject. I can only say what my impressions were before I came here. I had a general impression that the one great thing to do was to keep the coal dry. I knew something, of course, about pyrites, and I also thought that the more ventilation we had the better. I was a little doubtful about my theories, because I recollect, and I dare say a great many present here to-day recollect, the loss of H.M. ship "Dotterel," which occurred in the Straits of Magellan in the year 1881. She blew up, as was clearly proved, by two explosions. There was a court-martial, and at that court-martial the case was gone very carefully into as to how it was the first explosion occurred. The second explosion undoubtedly was the explosion of the magazine. A great deal of scientific and technical evidence was taken, and the late Lord Hood, who died a few days ago, who was president of the court-martial, took the greatest pains, and went into the subject thoroughly: the conclusion come to being that the first explosion was due to coal gas, which caused the second, which unquestionably was the explosion of the magazine. There was a great deal of expert evidence, and it was said there should not be too much ventilation of the coal. It was a new idea, and the Admiralty gave orders that a great deal of the ventilation which had hitherto been made imperative on board ships, and for which

ships had been specially fitted, was to be reduced, and there was to be very much less ventilation. I believe subsequently it was ascertained that the ship blew up through xerotine siccative; but that is a bye-question. I have only further to say, that I think, sulphur-dioxide gas is a very important question. I did not gather from all those gentlemen who have been good enough to address us on the subject, and who are interested in the works which produce the sulphur-dioxide gas, whether it has been very extensively used as yet on board ships. I understand that all the experiments have been exceedingly satisfactory; but, I did not hear much about the Board of Trade, or whether the Board of Trade were prepared to adopt it, or whether it is likely to be generally adopted in the mercantile marine. There are one or two things that we have learnt for certain, whilst there are several other things that we do not entirely know yet. But we have gathered—or I have gathered at all events, and I am quite sure that the lecturer intended us to gather—the fact that the depth of the coal is a very important matter: that when it exceeds a certain amount, then there is a very great danger. That is a source of danger which we hope to be able to provide against. Another question is that very vexed question to which several speakers have alluded—wet coal. I am very glad to hear myself that it is not of such great importance that the coal must be as dry as possible. My idea as captain of a ship would be that it is of very great danger to take any wet coal, but occasionally we were obliged to do it. In wet weather naturally the coal was often very wet, and a great many of us had long faces about it, but now we shall be more easy in our minds. Somehow or other we have in the Navy lately been extremely fortunate in regard to coal explosions. I think a good many of us in the Navy can recollect some very bad ones that have occurred. There have been small ones, I admit, but latterly our precautions have been sufficient to prevent any serious explosions. We always carry out the Admiralty instructions, which are to take off the bunker lids whenever we possibly can, and to attend to the temperature of the coal, which is regularly reported and recorded in the engine-room registers, and these precautions seem to have had a satisfactory effect. I only hope that if it is possible to carry out the sulphur-dioxide gas process and make all coal gas cargoes safer than they are at present, something will be done towards solving this question. I am sure we are very much obliged to Commander Caborne for bringing the subject to our notice, and I hope you will allow me to give him our thanks for his very interesting lecture.

Two or three points raised in the discussion having been submitted to Professor RICHARD THRELFALL, F.R.S., he has written as follows:—

Mr. Thomson appears to consider that the large scale experiment of the second New South Wales Commission as to the relative liability of wet and dry coal to spontaneous combustion, cannot be extended or made to apply to cargoes of coal on ships. The grounds of this objection are (1) that the Commissioners made their experiment on coal subject to side ventilation through cracks between boards of the bins, and (2) that they did not introduce an external source of heat such as might represent the effect of an engine-room. With regard to the second ground, it is perfectly clear that to have introduced such an element of uncertainty as a source of heat at one side of each bin, would have entirely prevented any conclusion being drawn from the experiment, for it would not have been practicable to be certain that the heat was applied equally to both bins. Also the danger from spontaneous heating occurs mainly in sailing-ships which are a long time at sea, and whose conditions were better represented by the Commissioners' experiment than they would be by a trial on a steamer, or with a bin exposed to heat

on one side. With regard to the Commissioners providing side ventilation, if there be anything in Mr. Thomson's objection, it must rest on the pure assumption that with some sets of conditions as to ventilation, wet coal might inflame spontaneously more easily than dry coal. It has, however, been proved over and over again that the sufficient and necessary condition is to admit air just rapidly enough to produce oxidation, and not rapidly enough to carry off the heat generated. If these conditions are satisfied, and not otherwise, will a spontaneous fire occur. The Commissioners did satisfy them in an identical manner for both wet and dry coal, and they did get a fire with the dry coal, and hardly any heating with the wet. They did, therefore, answer the question they set out to consider. The only possible difference that could arise, if a similar experiment were tried in the hold of a ship, would be in connection with ventilation. The Commissioners arranged their experiment so that there could be no doubt as to the sufficiency of the ventilation, both with the wet and the dry coal, and used a sufficient bulk of each to insure that the ventilation could not be so excessive as to prevent a fire by carrying off the heat generated. On board ship, with top ventilation only, which cannot be excessive in so far as the centre of the cargo is concerned, there is some difference between the facilities afforded to wet and to dry coal respectively. The wet coal would have its dust more or less caked together, and this would lessen the penetration of the air. It appears, therefore, that the difference in condition between the Commissioners' experiment and that obtaining in a coal cargo, would be in favour of the more easy firing of the dry coal, as compared with the wet under the latter conditions. The result of the experiment of the Commissioners, therefore, is that, even if wet coal be ventilated in a manner relatively more favourable to spontaneous heating than is the case on board ship, it nevertheless is far safer than dry coal. If wet coal be ventilated in a manner most conducive to the setting up of spontaneous heating, it will not heat: much less, therefore, will it heat if the ventilation is vastly less favourable to its doing so. In the German brown coal districts, the heaps of coal are often wetted on the surface, in order to cake the surface layer, and to stop the air penetrating and firing the heap. Commander Wilson-Barker favours excluding the air from coal cargoes. Nothing can be more effective, provided it can be done. I have never seen a ship, however, in which it could be thoroughly carried out: but if such a ship could be built, no doubt the effect aimed at would be attained. For this, however, considerable changes would be necessary. For instance, the coal would have to be trimmed nearly up to the deck, so as not to leave any considerable volume of free air: also, it must not be lost sight of that there is a considerable volume of air in the interstices of the coal. Personally, I do not think it would be possible to construct a sailing-ship with really air-tight holds, without going to an amount of trouble much greater than that of wetting the heap under the hatchways. Commander Wilson-Barker says he once carried a cargo of 1,880 tons, and that this would have been reduced to 1,770 tons had the damping process been employed. That is to say, presumably, the difference in weight, viz., 110 tons, would have been water. I do not know how this estimate is arrived at. The 110 tons is 6·2 per cent. of the weight of the coal, and I should think this excessive for moisture, simply put on the heap under the hatchways. Without seeing a plan of the ship, or knowing how many hatchways were used for loading coal, it is not possible to say just how much coal should have been wetted, had that method been resorted to. An allowance of 10 per cent. of the coal for the dust-heaps under the hatchways would in general be ample. This might receive up to 15 per cent. of water. If we start with 1,880 tons, we find on this basis that 188 tons would require to be wetted, and 15 per cent. of moisture on 188 tons is 28 tons of water. So

the cargo would have been reduced only to that extent, *i.e.*, say, to 1,850 tons. Distributing 5 per cent. or 6 per cent. of moisture through the bulk of the cargo, so far as our present knowledge goes, might not protect it, but 15 per cent. in the dangerous part would protect it very well, and it is a question whether in general the coal could be got to retain more. With regard to Commander Wilson-Barker's desire to know more about the experiment of the Commissioners, I can only say that the Agent-General for New South Wales, or the officials of the Board of Trade, would no doubt gladly furnish him with copies of the reports on application. The depth of the coal in the bins of the New South Wales Commissioners' experiment was 21 feet, which will no doubt satisfy Commander Wilson-Barker that his suggestion as to evaporation taking place from the surface, will not account by itself for the protection which the coal enjoyed. Full weight, however, is assigned in the report to the favourable action of water in cooling the coal; but this was not due to the evaporation after the coal had been once trimmed into the bins, as the curves of temperature will show; and the coal was quite wet at the close of the trial, as a mass of 245 tons was certain to be.

CONTINENTAL *versus* SOUTH AFRICAN TACTICS: A COMPARISON AND REPLY TO SOME CRITICS.

By Lieut.-Colonel F. N. MAUDE, p.s.c., late R.E., Commanding Hampshire Royal Engineers (Vols.).

Thursday, 6th February, 1902.

Major-General H. M. BENGOUGH, C.B., *p.s.c.*, in the Chair.

DURING the past eighteen months the papers have teemed with proposals and suggestions for the reform of our system of military training. These have been contributed by all sorts and conditions of men—statesmen, soldiers, journalists, and "the man in the street"; and, as far as my study of their writings has gone, all appear to start from the proposition that the fire of the magazine rifle has proved "unprecedented" and impossible to be faced. Since, if examination shows that this presumption is not justified by facts, these propositions not only fall to the ground, but become actively injurious to the efficiency of the whole Army, by impairing that spirit of attack on which alone all fighting which aims at a decisive victory is based, it seems necessary to analyse very carefully the facts on which they are founded, facing them in their naked significance without partiality, favour, or affection.

As a type of this criticism, I select the following passage from a little book on the war which has been very favourably reviewed and widely disseminated:—"Our infantry has been compelled to abandon the formations inculcated in the Drill-book, not because the Boers undoubtedly have shewn wonderful skill in availing themselves of cover, nor because they have selected positions with abnormal judgment, or because their marksmanship has been of an exceptional character, but *because they are armed with the Mauser rifle.*"

This sentence appears to me to embody in brief the whole position of the numerous critics of Continental methods, which until very lately were also our methods, for the training and employment of troops in war; they all, from M. Bloch downwards in varying degrees, according to their ability as controversialists, maintain the thesis that in face of the enormously increased destructive power of modern infantry armaments,

the principles laid down for the conduct of warlike operations in all countries require grave modification.

They have, however, all alike omitted to prove the first proposition of their syllogism, confining themselves to the mere repetition of such epithets as "unprecedented," "appalling," and the like; considering, no doubt, that the admitted fact that modern breech-loaders are stated to have a rate of fire of some 30 shots a minute compared with the three rounds of the old smooth-bore muzzle-loader, together with a ten-fold superiority in range, rendered any such proof quite superfluous; yet so very different are the conditions underlying the employment of weapons in the mass in the field from those which obtain on the practice ground, that I venture to hope I shall have little difficulty in destroying their assumption from its very roots.

Rapidity of Fire.—Dealing with the individual weapon and firer first, it is perfectly obvious that however much the mechanical process of loading has been accelerated, the time required for taking accurate aim has undergone no corresponding change; indeed, on the whole, it has been increased as a consequence of the greater mean range at which fighting takes place—obviously it take longer to get one's sights on to a target the size of a man at 1,000 than at 100 yards distance.

The point to consider is, not how often a skilled mechanic specially trained for the purpose can load and fire a weapon in a test for extreme rapidity only, but what rate of fire in the ordinary individual holds out the prospect of the maximum number of hits in a given time.

With regard to individuals, I can find no trace of any experiments, but for bodies of troops, such as sections and companies, a very comprehensive series was carried out both in France and Germany about the year 1880-3. In both it was found that for every body of troops there was a certain rate of fire per minute which gave the greatest "intensity" (*i.e.*, the best percentage in proportion to number of rounds and time occupied), dependent on the discipline and drill of the troops exercised, and that when that rate was exceeded the proportion of hits fell off inversely as the square of the number of rounds fired.

In France the best rate was found to be four rounds a minute, with the Gras rifle—whether as volleys or independent. In Germany, I am told, it was fixed at six, with the Mauser. And the time saved in loading by mechanical improvements since that date will barely suffice to increase these figures by more than one round a minute each.

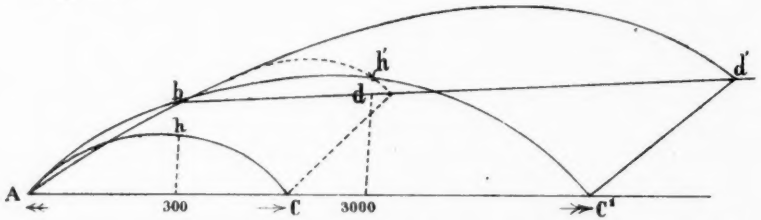
Actually, both the needle-gun and the Chassepot, being bolt guns, could be fired nearly as fast as the Gras or Mauser, hence the practical increase in velocity of fire resulting from all the mechanical improvements since 1866 to the present day does not exceed one round a minute—in other words, an average company cannot usefully expend

20 per cent. more ammunition in a minute now than formerly. Of course it can fire double and treble this number, but only with the certainty of missing its target, a proceeding which no authorities, to my knowledge, recommend.

Increase of Range and Accuracy of Fire.—At a target which cannot shoot back, both increase of range and accuracy of fire are obviously all clear gain; but when the target can shoot back, the question becomes much more complicated.

Because the power of the weapon is greater, both sides come under the disturbing influence of its bullets at longer ranges and their fire becomes mutually less destructive. During the course of a combat it is well known that the accuracy of fire falls off to an almost incredible degree, and the mean expenditure of bullets per man placed out of action previous to the introduction of long-range weapons never fell materially below 200.

Now let us consider the cases of two bodies of troops in similar formation, but armed with weapons of different ranges, when firing under average battle-field conditions. Some fire high, others low; some to the right, others to the left; but all the bullets have to move within the space swept out and bounded by the path of the highest bullet, of the two widest right and left, and by the ground. (See diagram.)



The solid figures thus bounded are not susceptible to an easy or exact analysis, but we can approximate to its significance by a formula adopted from the practice of naval architects.

For the purpose of comparing the cubic content of two or more hulls they use an expression called the co-efficient of fineness, and in like manner to compare the intensity of fire, *i.e.*, the number of bullets moving in a given cubic space, which fixes the probability of being hit in passing through the shot-swept zone, we can use a co-efficient of accuracy; and, assuming the accuracy in both cases equal, then the intensity of fire within the two spaces will be proportionate to their cubic contents.

Now since the accuracy in both cases is, by hypothesis, the same, *i.e.*, whatever the weapon with which the troops are armed, equal numbers of each body make equal errors in elevation and direction, and the

consequences of such errors increase as the range, these consequences can be expressed as equal fractions of the range; so that we can take the total cubic content of each solid as given by the formula—

$$k\left(l\times\frac{l}{a}\times\frac{l}{b}\right)=k\frac{l^3}{a\,b},$$

i.e., the chance of being hit in any particular case must vary as some function of the cube of the range.

If the co-efficient of accuracy becomes very great, *i.e.*, if all aim almost equally true, and the trajectory is almost parallel with the ground, the expression approximates to zero, and the chances of being hit become certainties—probabilities no longer.

There is a practical way of arriving at the same result which may be more convincing.

Take four pieces of tin, and on them plot out to scale the trajectories of two weapons under comparison in duplicate. Then connect each pair by a strip having the same width and fill both with flour. Then into each sprinkle and thoroughly mix up a number of currants equal to the number of bullets discharged by the line of troops. Get your cook to bake the cake, and send for the nearest school-boy and give him his choice of a slice. If he likes currants, as most of them do, I think he will be found to select a slice from the smaller one, as obviously it will contain more currants to the cubic inch than the larger one; and if now in your mind you convert the cake into an imaginary space of atmosphere with bullets in it instead of currants, it will be equally clear that for an equal number of bullets the larger space will be the safer.

Now combine the above with the question of amount and rapidity of fire to be faced in the time necessary to cross the shot-swept zone.

In the old days of Frederic the Great's time, men stood three deep, and could fire, say, four rounds a minute, which gave $450\times4=1{,}800$ bullets per 100 yards of front per minute, and the bulk of these bullets struck the ground within, say, 300 yards, few of them rising higher than 200 feet.[1] A body of men with modern weapons, firing equally wildly, would send their bullets 3,000 yards in distance and 2,000 feet in height.

But $900\times300\times200$ is only the $\frac{1}{100}$th part of $9{,}000\times300\times2{,}000$, and the time required to cross over the fire-swept zone is nowadays only ten times as great; so that for the risk to be equal, the number of bullets per minute would have to be ten times greater than it was in Frederic's time. But nowadays, troops will rarely stand even two deep to fire, and we have seen that, because the difficulty of aiming increases with the distance, the rate of fire cannot exceed materially the four rounds a minute

[1] See "History of the first Silesian War, 1742," by the Prussian General Staff. Also, "Kriegsgeschichtliche Einzelschriften, No. 28."

customary in the old days. So that we are still far from equalling the intensity of fire we had formerly to face.

There remains yet the flatness of trajectory to be considered, and this, too, works out in a most unexpected way.

If every man kept his muzzle horizontal when firing at fixed sight ranges, it is obvious that nothing could possibly pass the zone of ground thus covered; but unfortunately this is a condition practically never realised on service, and the moment it ceases to be observed the flatness of trajectory becomes an evil rather than an advantage. In the old days, if a man missed the first line, his bullet was almost certain to ricochet into the second, a couple of hundred yards behind it, but the same tremor of the hand that sent the bullet wide with the old musket causes it to fly a thousand yards clear of its object nowadays. The point may best be realised by the following simple experiment:—Take an ordinary garden watering hose with a rose nozzle, and turn on the water with a low velocity so that it dribbles out almost at your feet, then turn on a full head so that it spurts out in jets. In the former case you will saturate the lawn at your feet, in the latter the same amount of water will barely lay the dust.

So far I have considered only bodies of troops with the old and new weapons with approximate equal frontage, but it is well known that the Boers never attempted to fight in such dense formations as European tactics formulated. As near as I can ascertain, 500 men to the mile appears to have been their normal fighting density, therefore, either their shooting must have been far more accurate than that of the French, who in 1870 fought normally (on the defensive) 5,000 to the mile—and my authority denies them any special distinction as marksmen—or the fire was not "unprecedented," as others would have us believe.

Actually a comparison of casualty returns of the two wars, as far as at present available, shows us that as a fact it was never as against equal targets and under similiar conditions equally effective,[1] though in proportion to the number of rifles there seems to be overwhelming proof that it was individually better directed, which is only what was to be expected, when we remember that about one-third of the Boers, say all over thirty years of age, possessed a skill with the rifle acquired after game in the same topographical and climatic conditions, which exceeded by far anything our own men could possibly possess, and in which they were probably only equalled by the few British officers who have devoted the whole of their lives to big game shooting all over the globe; and of

[1] Compare Colonel Long's guns with the batteries Trautinann-Grügge at Gravelotte; the Highland Brigade at Magersfontein with the Prussian Guards at St. Privat.

the remainder under thirty, all except the foreigners had enjoyed opportunities of handling arms and judging distances such as no densely-peopled civilised nations can conceivably supply for their soldiers. Neither we nor any other race will ever meet such shooting in Europe again.

We must look elsewhere than at the rifles to find the true conditioning factor of the special phenomena of the present campaign, and I venture to suggest that if all the special circumstances of the case are considered we shall find "mobility" ultimately the predominant influence.

In no European campaign that we can conceive can "mobility" by itself play such an all-important part, for no theatre of war presents an equally favourable area for the development of this special quality, and no political conditions on the Continent would allow of the full evolution of its strongest points. In Europe time and space are all-important factors in strategy, for war which does not for the time being paralyse all civil existence is inconceivable.

A rapid succession of decisive victories which will end the war in the shortest possible space of time is the object of all modern strategy; but in the case of South Africa we were debarred by technical difficulties of transport from aiming at decisive results, and the Boers had everything to gain and nothing to lose from the policy of evasion which they so successfully practised.

As the problem must have presented itself to them, every day gained increased the prospect of European intervention, and every mile added to the length of our communications reduced our effective force at the front. Had the British Army system been really the wooden inefficient machine the Boers, together with all our home critics, believed it, humanly speaking, it is certain that with the 70,000 men and line of communication troops it was designed to furnish, we could never have got to Pretoria, or even maintained ourselves in Bloemfontein; but when the ricketty old machine suddenly developed (as some of us, who had, perhaps, studied its fundamental principles to better purpose than the critics, had ventured to predict) a surprising reserve of vitality, and sent out fully three times the forces it was expected to supply, the bottom was knocked out of the Boer calculations, though even then the tactics of evasion remained the best they could employ.

But these tactics required a practically unlimited depth of area for their employment, and where in Europe will such a depth be available?

Again, in no other theatre of war except, perhaps, in North America, can the advantage of mobility be so entirely on one side as in South Africa, for nowhere else can the difference in "condition" between the horses of the mounted forces be so extreme.

This difference of "condition," I take it, was the ruling factor throughout the campaign, for it is enough to substitute well-trained cavalry in high condition for the broken-down wrecks we had in the Free State to see what all-important results must have followed from their employment.

An Indian, Austrian, German, or French division carrying the same weights as ours would have covered the 74 miles from Ramdan into Kimberley without distress in 24 hours, and could have ridden into Bloemfontein from the latter place in about 34 hours. In front of such troops every attempt made by the Boers to stand must have resulted in another Paardeberg and consequent surrender, and this was the line of action every cavalry officer with whom I discussed the matter, and that was a pretty large number, had resolved to take if he got the opportunity.

Unfortunately, none of us foresaw—and I submit that we could not have foreseen—the utter breakdown of the horses which actually happened, for all military history furnishes us with no similar example.

Our horses in the old sailing-ship days were often far longer at sea under far worse conditions without suffering to the same extent, and in India we have railed them equal distances without inconvenience, and in previous South African experience it appeared that only the deadly "horse sickness" had to be feared, a calamity which, however, we seem to have escaped. Into the causes which led to this deplorable breakdown I do not propose to enter—trustworthy evidence is still not forthcoming; but the facts being as they were, the tactical procedure of our infantry grew out of the conditions quite naturally.

It could never be to our advantage to force a decision by deliberate orthodox attack methods, for the Boers would only have mounted and cantered away; all we had to do was to hold them in front by as weak a line as possible whilst our jaded mounted troops tried to work round their flanks. Against an enemy known to be averse to counter-attacks the extreme extension we adopted was justified by results, but it would be a very unsound generalisation to assume that similar extensions would answer against an active European drilled Army, or would suffice against an enemy whose flanks were secured by natural obstacles and who was determined to stand.

Substitute for the Boer mounted infantry, ordinary European troops in the usual proportions of the three arms and of approximately the same numbers.

Now, the first actions of the war—Talana Hill, Elandslaagte Belmont, and Graspan—were quite sufficient to prove that 500 men

to the mile were quite inadequate to stop British infantry, and as a consequence the Boers would have had to thicken their line.

But it is obviously easier to find or create good cover for 500 men to the mile than for 1,000 or 1,500; the advantage of concealment would thus have largely diminished, and at the same time our fire would have told more rapidly, not only because the cover was less, but because there were a larger number of heads to be seen, and the moral effect of losses increases more rapidly with the greater density of the bodies on which the losses fall. Thus, step by step, the Boers would have been driven back to the formation of supports and reserves, and this is where the real difficulties in the conduct of a defensive action commence, and which, to my mind, in normal ground are almost insuperable.

The Boers made great use of covered communications to their fighting positions, we are told, exactly as European troops have always done in siege works, but the execution of these works is mainly a question of time; and if their rate of movement had been reduced to ours, this time would not have been afforded them so liberally; and European troops do not carry with them black labour for their trench work, but have to do it themselves at the sacrifice of often essential sleep and rest. Fewer trenches and more men to the mile would have been the consequence, and since their numbers are assumed as equal in each case, this thickening of the line could only be attained by a diminution in the extent of front, and, say, 20,000 men would have found about four miles of front the very utmost they could have undertaken. But to turn a front of four miles is a far simpler and speedier operation than to turn one of twenty to thirty, hence the need of "frontal attacks," assuming these to be always and everywhere "anathema," as our Press critics would have it, would not have arisen.

Mr. Winston Churchill, in one of his letters from Colenso, calculated the advantage to the Boer due to his mobility as five to one over our infantry. I confess I believe he underrates it. I should put it at ten to one. For judging by such maps as I have seen, I believe that 100,000 infantry with guns could not have held the line of the Tugela against us with equal success owing to the impossibility of rapidly reinforcing the threatened sections of the line in that exceptionally difficult country.

So far I have dealt with the problems presented by the Boer War from a theoretical standpoint only; let me now call in the aid of experimental research to establish my positions synthetically.

To the student of tactics, the battle-field, and its results historically recorded and critically investigated, is to the progress of his knowledge what the laboratory is to the physiologist, the chemist, and the engineer;

and though, fortunately for humanity, if not for the soldier, battles are of rare occurrence, and cannot be appealed to to settle every theory or fad; considered in their broad outlines over a sufficient space of time, they do furnish us with *data* which can be handled and dealt with precisely as the results of any other branch of physical research. The limits of variation are, indeed, far wider, and this it is which constitutes the extreme difficulty of the subject, and accounts for the many variations of opinion that one still encounters; but within these limits the facts are absolute, and afford firm foundation for further progress.

Let me now beg your closest attention to the following summary of the process of tactical evolution which has been in progress ever since fire-arms became the dominating influence in warfare.

The first consideration present to the mind of any commander who makes out to beat his enemy is, that the enemy also has a will of his own and may turn the tables upon his opponent; the best plan of battle, therefore, may prove illusory, unless it is itself founded on the power to resist a sudden attack. It is the principle of the "engaging" guard in swordsmanship, and just as no fencer expects to kill his man by remaining on guard eternally, so no leader anticipates victory except as a consequence of an appeal to attack, for which disorder resulting from movement in the attacking forces may afford him the opportunity.

With this purpose, from very early times, both sides drew up in such order as ensured the protection of their front by fire as long as the order remained intact; and since the early weapons were slow in loading, they adopted a formation of open files, twelve to sixteen deep, in which each man in succession delivered his fire and then retired through the intervals to reload. In this manner, with good drill, the whole twelve or sixteen men could discharge their pieces within the minute, giving six to eight bullets per yard of front; but it is clear that the order was especially liable to be broken by men falling across the intervals, and took a very large number in proportion to the front covered. But though the fire of these dense columns was most formidable for defence, it was almost useless in attack; practically they could only charge home with the pike, and six bullets a minute per yard of front was sufficient argument against such a proceeding.

As artillery was still in its infancy, it was impossible to rely on its aid alone, and to meet the difficulty recourse was had to skirmishers, known then as "die verlorene Haufe," whence "forlorn hope," who fought individually in advance of the columns and did what damage they could to the enemy; but then, as now, it was fully recognised that "unshaken infantry," were unassailable in front.

This turned attention to the flanks,[1] then, as now, the weakest point and every effort was made to rest them on insuperable physical obstacles, and obviously there is a better chance of finding such obstacles for a long line than a short one. To lessen the density of the line and increase its length was then the object of every commander, and this could only be done by increasing the rapidity of the loading of the individual arm, either by improving the weapon itself or by a higher standard of drill, or by both.

Thus, step by step, the ordinary three-deep line was evolved as the normal fighting formation of all nations, and as it was much more mobile in attack than the old column it had displaced, and its fire far more effective, because it overlapped the flanks of the columns, the importance of the skirmisher waned and he only retained his position in special circumstances as in the case of columns for the assault of a breech, where we still find the name, though no longer the thing, in the Peninsular times. It was the striving after increased fire-power which primarily led to the intense importance attached to drill, and incidentally solved the problem which civilians even nowadays find so hard to comprehend.

In a period of chronic warfare between Armies more nearly equal in respect to armament, equipment, and recruiting, than have since confronted one another, it was found as a matter of experience that the best-drilled troops always retained their power of combined action, *i.e.*, remained formidable longer than less-drilled ones, and the point was accepted as an axiom that needed no demonstration, which in the existing state of psychology could not have been given if demanded.

From these long-continued struggles under uniform conditions, a state of dead-lock presently resulted. The want of roads made bold manœuvring almost impossible, except to leaders who possessed in an unusual degree the power of infusing a portion of their own fiery determination and spirit into the men under them, and hence when troops engaged more or less frontally, they mutually destroyed one another before either would yield. A victory was almost as irreparable as a disaster, for recruits took years to train and each made soldier in the ranks represented a cash capital alone of some £100 sterling, and there were no national debts in their present form available.

The average leader found it harder to resolve to risk all to win all than he does nowadays, and small risks and equally small profits became the order of the day, with the result that hasty fortification was had

[1] Some few years ago, Colonel Hime, R.A., made calculations on the same basis, which substantially agree with my conclusions.—See "Stray Papers on Military Subjects."

recourse to to an extent which has never since been equalled, probably never will be again in Europe.

This led to a war of stratagems, and hence we derived the meaning still current in this country for the term strategy, and to which we owe the thoroughly mistaken notions as to the true "art of the leader," which finds its expression in every newspaper, magazine, or other vehicle for printed information by which we are surrounded. Above the pettiness of this game, only such great commanders of men as Marlborough and Villars succeeded in raising themselves, but the true measure of their greatness has never yet received justice in this country.

Meanwhile, the Prussians were preparing in all silence a surprise for the rest of Europe, which exceeded in relative magnitude their subsequent revelation of fire-power in 1866. By means of the iron ramrod and the no less iron discipline of the "Alte Dessauer," they succeeded in more than doubling the rate of fire of their infantry; and since this rate was only attained by dint of more constant drilling, they had acquired also a steadiness and cohesion which made them still formidable in attack after losses which would have broken any other troops in Europe. The command of these troops was about to pass into the hands of an absolute monarch, responsible to no one for the sacrifices he chose to demand of them, and competent (as events proved him to be) of inspiring that devotion to his person which is the principal characteristic of a truly great leader, a power which time and again has outweighed all possible advantages of armament, numbers, and position; and this leader was about to appear on a theatre of operations almost as different in its characteristic features from the "Cockpit of Europe" as the Transvaal from the Lorraine.

Never, perhaps, has a more complete revolution taken place in all the conditions of war, and it was some time before professional experience could adapt itself to the sudden change.

In the absence of a mobile field artillery capable of preparing the way for the infantry, the fighting was most bloody and arduous, and the King's resources both in men and money were distinctly limited.

To economise their lives he first had recourse to his cavalry. Now, in old days, when the 18-foot pike was still the queen of weapons, it had been a physical impossibility to break unshaken infantry by shock alone. The cavalry, therefore, had taken to riding up at a trot to convenient range of the squares, and from thence disturbing their order by the fire of carbines and pistols until the confusion became sufficient to allow them to press home, which they did, still at a trot, because their training generally was not high enough to enable them to keep close order at speed.

The pikes had long disappeared, but the old tradition, "Cavalry cannot charge unshaken infantry," retained all its old vitality, and the attempt of the Austrians to ride home at Mollwitz had not encouraged them to try again, but the King and his cavalry generals, Ziethen, Seydlitz, and Driessen, set to work to raise the standard of individual horsemanship till charges at full speed with closed files again became practicable, and when the ground allowed, as at Roszbach, the combination of fire and shock tactics proved irresistible and most economical to the victor. But the ground did not always permit, and then the King had recourse to his celebrated "oblique order," the essence of which was to concentrate an overwhelming fire on one extremity of the enemy's line, and, as disorder set in, to roll up the whole front in succession.

What was needed for success was extreme endurance on the part of the line on which the brunt of the fighting fell, great manœuvring power and, as a consequence, space to manœuvre in, which the great plains of Prussia abundantly afforded.

The Austrians and Russians now took refuge in relatively broken ground, but it was only their enormous numerical superiority which enabled them to do so. With equal numbers, Frederic's superior mobility would have immediately been directed on their lines of communication; but with two widely separated antagonists, each his equal in strength, he was compelled to turn from one to the other, and could never finish with either; and the army not directly threatened used the time gained for entrenchments on a most formidable scale, armed by guns heavier than any he could bring against them.

These works were generally of a bastion trace, always designed to give mutual support, the profile with a 9- to 12-foot ditch, in itself a serious physical obstacle to assault, and every possible use was made of abbattis and other obstacles quite as formidable as wire as used in the present war, and actually more difficult to cut a path through; behind these the infantry stood with ranks of loaders ready to pass fresh muskets to the front, and along the whole, batteries of 12-, 18-, and even 24-pounders were interspersed in groups of four to six, at 15- to 18-foot intervals, to a total number of 200 and upwards. Yet against these the Prussian infantry flung themselves, sometimes successfully, more often not, but always fighting till sheer physical exhaustion compelled cessation. Against these entrenchments the King wore his armies out, and the war was brought to a close by mutual inanition; a long peace ensued, economy became the order of the day, and the long-service army eat its heart out in idleness in the usual way.

Meanwhile, the progress of social evolution was preparing another and most startling revolution in the whole art of the employment

of troops in warfare, but the process was so gradual that the impending change remained entirely unsuspected by its contemporaries.

Outside the theatre of the Seven Years' War, Western Europe had been making enormous progress in population and agriculture, villages had grown into towns and towns into cities, and for their convenience a great network of roadways had come into existence.

The magazine system of supply, which had arisen in the previous century (seventeenth) as a consequence of the devastation of the Thirty Years' War, and which had mainly conditioned the strategy of Marlborough and Frederic's epoch, ceased to be a necessity, and it became again possible for Armies to live upon the country; but the change was not apparent to the old routiniers of Prussia and Austria, and their failure to appreciate its possibilities brought about ultimately the downfall of the old school of warfare, and opened the road for Napoleon's subsequent career of victory.

For when the Revolution in France had destroyed the old Royal Army, and the country was called upon to fight for its existence without money, credit, or supply trains, it had to fall back on the primitive methods of barbarism, and to make war support war. It was a counsel of necessity, not of perfection, as events were ultimately to prove, but for the moment it proved a veritable philosopher's stone, opening a road to Armies which formerly gold alone could have supplied.

Because there were no magazines and convoys to consider, the French Armies could move faster, and in proportion as they moved faster they had a wider area to live upon. Where, in 1792-3-4, the Austrians and the Prussians, hampered by lengthy communications, could only subsist hundreds, the French managed to feed thousands, and it was sheer weight of numbers, not superiority of tactics or strategy, that drove the allies ultimately beyond the Rhine and freed the French frontiers.

Unfortunately, this change coincided with a marked alteration in the tactical methods employed by the French Armies, and, as so frequently happens, the cause of their successes was sought in the obvious and visible, instead of in the action of silent, unobtrusive, social evolutionary changes. Since the consequences of these tactical alterations are in full vitality at the present day, and are largely, if not entirely, responsible for the confusion of thought still existing all over Europe, I may be perhaps excused for dwelling on them somewhat in detail.

At the close of the Seven Years' War, the Prussian Army was the military model for all Europe, and the principles of the "line" were embodied in all drill-books. The French, however, never took kindly to the "line," mistaking the rigid brutalising discipline of the Prussian parade-ground for the spirit of the thing, a mistake we fortunately avoided.

The dislike for the parade-ground found its chief support amongst those officers who had returned from America and had fought side by side with the Red Indians—the most perfect skirmishers in the world. And like the present advocates of extreme Boer methods, forgetting the extraordinary diversity between American and European conditions, they endeavoured to raise skirmishing to the one and only form of infantry action.

Similar tendencies were at work in all other Armies, notably in our own, the Prussian and Austrian (Dietrich von Bülow was their principal exponent), but it was only in France that, thanks to the destruction of the old Army, they obtained full scope.

The early French Revolutionary Armies were little more than a *levée en masse*, quite destitute of the precision of drill and the resulting spirit of self-sacrifice, which alone renders "line" fighting formidable.

Though they took the field in "line" regulations, they failed altogether to stand up to the work, and under fire they broke up into dense swarms of individual fighters, through the bravest going forward, the others hanging back, and since time for a more thorough training was unattainable, the practical soldiers who now began to come to the front, and who, thanks to the previous discussions, were thoroughly familiar with the skirmishing question, made the best of the matter and evolved a system based on skirmishers and small columns which at least rendered it possible to fight in some fashion, though not in the best.

The essential point is, that the system was a makeshift expedient, in which men became skirmishers first and learnt discipline afterwards; whereas in our own Light Division, whose origin also dates back to the American forests, we made disciplined soldiers first and grafted skirmishing on to their training afterwards.

The *début* of this new infantry was far from satisfactory, taking into consideration the numbers engaged. The disciplined British, Prussian, and Austrian battalions simply swept them away with their fire, and often buried more than their own numbers. Nothing whatever occurred to shake the faith of the experienced generals on our side in the superiority of the traditional system. But they were unable to meet the French numbers on an equal frontage, and being at the same time tied down to the defence of their communications and magazines, they fell into the habit of splitting up their commands into numerous small columns, of a couple of brigades, a battery, and a few squadrons each; and in the attempt to execute combined operations over a wide front, individual columns got astray and left openings through which the French poured. In 1795 and 1796 this habit of operating over wide fronts had attained such magnitude that armies of 30,000 Austrians are found fighting over 30 miles of front, as at Stokach, Biberach, etc.[1]

[1] See "Geist und Stoff im Modernen Krieg," by C. von B. K.

Meanwhile, on the survival of the fittest principle, the French Army was developing into a war-seasoned body of veterans. The Revolution was driving the pick of the race into the Army, and the level of intelligence in the ranks was far above that supplied to the other Armies in Europe by their antiquated recruiting methods. The French were in earnest, and the generals fought with the guillotine behind them. The Austrians, as a nation, hardly felt the pressure of the war at all, and their Army was still divorced from the nation at large, recruits and money were grudgingly supplied. Hence, whilst the French became daily more formidable, the Austrians declined in value and her generals lost the power of initiative.

Things were in this state when Napoleon appeared on the scene at Savona, and realising at once the essential weaknesses of the Austrian "cordon" system, massed every available man, horse, and gun against his nearest opponent, crushed him at the Monte Legino, and rapidly turning upon the others, overwhelmed them in succession at Dego, Cossaria, Ceva, etc., the essential point to note being that he won by sheer weight of numbers and the resistless energy in execution he managed to inspire into all his subordinates, not by superior tactical methods.

This turn of fortune inspired the French infantry with the true spirit of invincibility, and from henceforth, until he discovered the "mud of Poland," they fought well under his eye—in any and every formation—and the improvement in their quality is distinctly traceable in the growing percentages of killed and wounded their casualty lists reveal.

I need not linger on Ulm and Austerlitz, for Jena is the point on which all modern tactical evolution turns. The Prussian Army which faced Napoleon on 14th October across the Landgrafenberg, though outwardly a replica of what it had been forty years before, inwardly had lost all its original spirit.[1] For economical reasons, the number of men with the colours had been constantly reduced until at length the average duration of the training had sunk to only one month in the year, and the staff throughout, though very highly educated, had had all spirit of initiative crushed out of them under the despotic rule of the old King. Yet, in spite of all their faults and disabilities, they did, as a fact, succeed in placing their army in a position which ought to have ensured Napoleon's destruction.[2]

Want of initiative, want of the power of combined action in the field in all ranks, paralysed all their efforts, and the result of the day was, as we all know, one of the most decisive victories for the French in history, which they followed up by a pursuit which rendered further resistance impossible.

[1] Max Jähns, "Geschichte der Kriegswissenschaften."

[2] Von Lettow-Vorbeck, "Krieg 1806-7"; and Clausewitz.

Essentially it had been a conflict between a peace-trained Army, led by asses, against war-seasoned veterans, led by lions, and the result ought not for a moment to have been doubtful; but the principle of the "line" proved its soundness by the tremendous punishment it inflicted on its adversaries, both at Jena and Auerstädt.

To admit the soundness of the tactical forms employed, however, would have been to condemn their own competency in employing them, and this the Prussian officers very naturally shrank from. Hence, on paper, the whole blame of the failure was laid upon the forms, and from this time forward the "line" became "anathema," and remains so even at the present day.

To revive the "line" at the moment would have been in any case impossible, for the conditions of peace imposed by Napoleon could only be evaded by curtailing the period of training to the shortest possible time, and under these conditions skirmishers and small columns became the only possible expedient. Similar conditions, or nearly so, prevailing in all the Continental States, the same policy was adopted, and the "line" disappeared from Europe until its glories were revived in the Peninsula.

Meanwhile, the French infantry had reached the turning-point of its improvement. The losses of three years' consecutive fighting and marching had already led to the conscription for the years 1807 and 1808 being anticipated, and once the horrors of the Polish winter campaign began to be realised these conscripts no longer came willingly.

The problem was to make them fight at all, and the solution was found by the action of the French artillery at Eylau and Friedland under Senarmont and Drouet respectively. Artillery is not an arm that can be improvised—hence the part it played in the earlier wars had not been imposing—on the other hand, it suffers less deterioration in quality in the field than either cavalry or infantry, and by this time it had become a highly mobile body, capable of exact precision in evolutions, and the task of galloping half a dozen or more batteries up to case-shot range had at length become possible.

Whereas in Frederic's time the infantry had primarily to rely on itself for the attainment of the fire superiority, which, then as now, alone guaranteed the successful execution of the final assault, now it became possible to relieve them of a great portion of this most arduous task, and how the infantry fought was almost immaterial, provided *they could be induced to go forward at all*.[1]

But Napoleon realised, as no other leader ever has done, that the harvest of victory can only be reaped by pursuit, and successful pursuit

[1] There is a legend in the French Army that the Imperial boot occasionally was called on as a last reserve to supply this inducement.

is only possible when the spirit of an army has been thoroughly shaken by slaughter. Hence resulted the typical form the battles of his later years nearly everywhere assumed.

They commenced by the deployment of dense lines of skirmishers with supports, who engaged along the whole front and were met by corresponding formations on the other side. Then ensued a long-continued fire fight by which the enemy was misled as to the final point of attack and induced to use up his reserves. The French, who now no longer intended a decisive skirmisher assault on the old lines, could afford to nurse their reserves better. So that after some hours' fighting the balance of fresh unshaken forces still in hand was largely in their favour.

Then came the artillery preparation by massed batteries at case-shot range, and as the Prussians, Russians, and Austrians generally elected to meet this in columns standing up on the exposed slope of the position (note the Duke's comments about Ligny), the slaughter was usually terrific.

To take advantage of this havoc, masses of cavalry were then let loose (at a trot to prevent a universal bolt as sometimes happened), and behind the screen of dust and confusion, a whole corps was marched up, the intention being to occupy the gap in the enemy's line without firing, in order to be available for further action against the enemy's reserves. Hence fire action became dissociated from the idea of a decisive attack, and rigid absolute obedience, irrespective of skill at arms, became the ideal of the infantry soldier.

We, in England, at least, know how it fared with these principles in the Peninsula and Waterloo, but the Continent was then and has always remained too busy with its own affairs to study our methods.

When, on the evening of the 18th June, 1815, the Imperial Guard finally recoiled, broken and shattered beneath the volleys of the 52nd and the Guards, the night of a great peace descended on the military world of Europe. Everyone felt that their life-work was done, and they settled down in a comfortable routine to doze out the remainder of their mortal existence. Only in Prussia was the lamp of military learning still kept burning; this, not because of any unusual development of the military instinct in the race, but because the principle of *universal* short service compelled them to study to enable them to act as instructors to their men. This is the true secret of Prussia's present military pre-eminence, and nothing else.

But up to the end of the fifties, there is very little trace of intellectual effort or research in the vast majority of their productions; with the exception of Clausewitz's masterpiece, the bulk of the publications were biographical, and almost entirely confined to the period after Jena.

Generally, they lived on the Napoleonic legend, and the Seven Years' War was looked on as barren ground; they lived on oral tradition only, and it was natural that the tactics to which they believed their final victory to be due should have received special attention. It was only with the accession of King William I. and his selection of Moltke as Chief of the Staff, that those men who had spent their years of isolation on the frontiers in professional study can be said to have commenced to reap their reward.

The influence of von Wrangel and of Prince Frederic Charles was also productive of good results, but at best the intellectual standard of the Prussian Army was not a high one—men were too much absorbed in "the daily round, the common task" of preparing for inspections to find the time or mental energy the useful study of military history requires—and from the nature of the case inspections were all based on the tradition of the Napoleonic struggle.

As the generation of officers which joined the Army subsequently to the great wars began to come to the front, a marked divergence of principle became manifest between the views of the staff and the regimental officers, and the introduction of rifled small arms and of the needle-gun not only favoured the latter, but cut the ground from under the feet of the former, whose arguments, based on experience, could be met by the rejoinder that the new weapons rendered all such experience illusory, a line of reasoning with which we are all sufficiently familiar in our own country at the present moment.

The pamphlets of Captain May—"The Tactical Retrospect" and the "Prussian Infantry"—together with Bronsart von Schellendorf's reply, though not published until after 1866, are typical of the whole controversy and exhibit in the most glaring manner the limitations of each party. May viewed battles as essentially decided by a firing line of companies much as in the early days of the French Revolution, and expected the highest results from the independent action of the individual skirmisher: his book, in fact, was but a revised version of Bülow's work, which must have been familiar enough to him.

Von Schellendorf, as spokesman for the General Staff, reminded his readers that battles were not won by the untutored impulses of excited individuals, but by the combined interaction of disciplined masses, taking as his model the recognised Napoleonic type; but both ignored the revolution in the conditions brought about, not by the breech-loader, but by the increased range of the muzzle-loader, which, as the experience of the American Civil War abundantly demonstrated, rendered the case shot preparation by artillery for the time being an impossibility, and thus threw one back on the old Frederician pattern of every possible rifle in the fighting line and a minimum of reserves.

Moltke may or may not have said, *à propos* of the American War, that "there was nothing to be learnt from this struggle between two mobs," but the wide circulation given to the story shows the bias with which events across the Atlantic were regarded in Prussian circles, an attitude of mind they have since had cause to regret, their progress in tactical science otherwise would have been much facilitated and many a life been saved in 1870. For actually the American War summarised within three short years the whole evolution of tactics during the previous century upon the Continent and disproved in most startling fashion all the current fallacies of the period.

The topographical features of the country, the absence of good roads, and the extreme sparseness of population, from the first threw back the strategical possibilities to the days of Marlborough. Magazines and convoys obtained their old importance, and these destroyed the mobility of the contending forces to such a degree that time for important entrenching work became available. The increased range of the rifle kept back the smooth-bore artillery chiefly employed by both sides beyond effective case-shot range, and hence the two opposing infantries had to fight out the issue by themselves.

Beginning with skirmishers and sniping operations they soon found out that no decisive results were to be obtained that way, and realising all that was at stake in the contest, the whole race, though the most individualised and intelligent in the world, voluntarily adopted the sternest methods of discipline and drilled themselves into such cohesion that presently we find them rivalling the endurance of the staunchest veterans in their desperate assaults upon each other's works.

It has been much the custom to see in these losses the proof of the tactical incompetence of their leaders. Viewing the war as a whole, nothing appears to me further from the truth, for by no other policy could the end of the war have been attained.

They could not manœuvre with freedom—the absence of roads was against that—hence the attacks had always to be, locally, frontal, and not only did the long range of the rifle keep the artillery at too great a distance for the act of preparation, but it increased the fire-swept zone from 300 to 1,000 yards at the least, which had to be crossed practically in one movement, without firing, since the loss of time and the exposure in loading (standing up) was fatal to the forward impulse of the whole.

The outlook for the attack has never been so desperate: on the one side seasoned soldiers, behind loopholes in skilfully designed entrenchments, unhampered by serious artillery fire; on the other, upright targets, whose one hope of safety lay in the rapidity of their forward movement.

Realising this the attacks were made with the utmost resolution, line following after line, the hinder one carrying on the wreck of the troops in front; and when experience showed that two lines did not suffice they increased the number to four and five, thus attaining in 1864 to a point the Germans only began to reach some twenty years later.

Heavy losses and occasional repulses were inevitable under these conditions, but the line formations rendered it possible to execute these attacks with only one-half the number of men to the mile, which contemporary European methods (not British) would have entailed. The percentage of loss with the latter would probably have been lower, but the aggregate, due to the greater vulnerable area exposed, would undoubtedly have been higher, and it is with aggregates, not with percentages, that the nation (not the soldiers) have to reckon.

But of all this the Germans remained in ignorance, and their experiences of 1866 only tended to lead them further astray. The campaign in Bohemia was decided primarily, not by the breech-loader, but by the higher initiative and individuality of all ranks, the direct (if unforeseen) consequence of the provisions of Scharnhorst's law of universal service, which alone rendered Moltke's strategy a certainty. The Austrians were recruited by conscription for seven years with paid substitutes and re-engagements, and as a consequence the whole Army was paralysed by centralisation. But these causes had operated so gradually and imperceptibly that their influence escaped the attention of the critics, who were carried away by the visible consequences produced by the breech-loader.

Only one observer, General Dragomiroff, at that time military *attaché* to Steinmetz, noticed the point, and speaking of the alleged unparalleled harvests reaped by the needle-gun, he asked "Have you all quite forgotten the volleys of the British infantry in the Peninsula?" And in truth, against troops handled as were the Austrians, any weapon would have sufficed to inflict a similar punishment. But the Prussians surrendered themselves fully to the new illusion, and when two years later it dawned on them that they were no longer the only bearers of the new fetish, but, on the contrary, were presently bound to face a weapon which could be fired twice as fast and killed at four times the range as their own—their outlook became far from attractive.

When the Franco-German War was over, it was hastily assumed in this country—indeed, everywhere—that the Prussian tactics had been deliberately framed to meet the special emergency. No assumption, however, could have contained greater fallacies; more truly their tactics might be termed the outcome of a council of despair.

Strategically, they knew that their blows would be aimed at the enemy's flanks, but, tactically, being better informed on this point than our amateur critics of to-day, they were aware that all turning movements end locally in frontal attacks, and the prospect of having to close in on the enemy from 2,000 to 500 yards practically without firing a shot, and, as they believed, with little assistance from their artillery, was a prospect to shake even the boldest. Nor was the difficulty over even when they got within the limit of their own range, for between 600 and 500 yards, their first effective firing position, the Chassepot was at least three times as accurate as the needle-gun, and it was known throughout the Army that the French intended to meet them in line behind entrenchments, thus bringing roughly five rifles under cover against each skirmisher, who showed, when standing, six times the area, so that the odds against the Germans stood approximately, irrespective of the quality of the men, as $(5 + 4 + 3 + 2 + 1) \times 3 \times \frac{6}{2} = 135$ to 1—about; and this was not all, because the Germans reached their first position, blown, excited, and largely out of the control of their officers. It was as if a flurried and excited man found himself compelled to fight a duel with five adversaries, all comfortably under cover, prepared to meet him.

There was nothing in their regulations to prevent their advancing in "line," and now and again they did so (by companies, notably at Mars-la-Tour and St. Privat—see Hoenig and the regimental histories), always with the result of bringing a far larger number of rifles to bear under better conditions, but generally they attacked in skirmishers and small columns, with the consequences depicted in the following quotation from Meckel:—

"Looking back on the past, we see quite another picture. The pitiable self-destructive belief in the unavoidable disorder and in the impossibility of guiding the fighting instincts of the individual finds in the events of 1870 its own condemnation. There, too, we heard the drums beating and saw the colours waving, and whole brigades dashing recklessly across the open, only to break before the unshaken fire powers of the adversary, and then every trace of order disappeared in the confusion of the independent order of fighting. Woods, villages, hollows, hitherto empty, were suddenly crowded with stragglers, and the open fields lay tenanted only by the victims of premature violence. But reverse the order of the proceedings: let the thunder of the guns go before the beat of the drums, the roar of musketry before the bayonet, and skirmishing in its old signification before the assault, *not follow after it*, and the battle will again assume its normal appearance."

The Germans were ultimately everywhere victorious in spite of the inequality of armament conditions, not because of their tactics, but because the strategic direction of their armies was immensely superior to

the French, and the leaders held on with dogged pertinacity until the strategic design had time to work. Ultimately, after Metz, they learnt to wait for the guns to do their work, but by that time the French troops went into action half-beaten already, and relatively a few common shell sufficed to give the final impulse to their tottering structure of discipline; but the easy success of the artillery continued for years afterwards to exercise an effect on tactical progress, which no student can afford to neglect.

There exists in every community of men, a certain section of extremists who seem intellectually incapable of sifting evidence; with them personal impressions count for everything, and their own views always appear to them of surpassing interest to the world at large. The German Army is no exception to the prevailing rule, and almost before the smoke had drifted clear of the battle-fields, busy pens were at work to disseminate their hasty generalisations founded on insufficient *data*. I need not recapitulate the names—they are familiar to every student of military literature.

We in England were placed in a difficult dilemma. It was evident that great changes had occurred in the science of warfare, and, except the breech-loader, there was no obvious factor or factors to account for them, and we were limited almost exclusively to hearsay evidence; further, the study of tactics and military history in this country had been for years almost extinct, and those who, in spite of all difficulties, had continued to struggle against their surroundings, had been compelled to draw their inspiration from Continental (French and German) sources, both of which started primarily from the skirmishers and small columns of the Revolution, the very system which had failed consistently before the British line and the true skirmishers of the Light Division.

The distinction between the three forms is as follows:—The business of the true skirmisher is to inflict annoyance on the enemy without risk to himself; all the cunning of the Red Indian and the "slimness" of the Boer are here in their proper place; a wide choice of position, *i.e.*, large intervals, is an inseparable condition for his success.

The "line," on the other hand, has to crush the enemy by overwhelming fire, and its own fire is its best protection; individual choice of position is here out of the question.

The French Revolutionary system and its descendants is a hybrid between the two, with the defects of both and the good qualities of neither; the man never knows whether he is to obey his officer or to act on his own judgment. If the degree of extension is sufficient to afford individuals space enough to exercise their private judgment in taking cover, the number of rifles is too small to make head against the enemy's return fire, and if the men are crowded together so as to get more rifles

in the firing line, they start with that sense of dissolution of control which it would be better to leave the enemy's fire to effect. Why do your adversary's work for him?

We were led to believe by our first informants that the fire of the new weapon was so terrific that closed bodies could no longer exist before it, and in the absence of statistics no reply was possible; but, surely, this would have applied equally to the small four-deep columns in support which were generally equally conspicuous and drew the enemy's converging fire, and to these small columns all foreigners stuck persistently. Either the enemy's fire was aimed or not; if it was aimed, then the small columns were certain to suffer more than the line. If it was unaimed, then the formation is immaterial. The rain falls on the just and unjust alike; but more tons fall on the square mile than on the acre, and more in an hour than in a few minutes.

Actually we have known for the past twenty years that the casualties inflicted by this terrific fire were not only not excessive, but always well within the limit of well-disciplined troops to bear, and it is on this line that the common sense of the bulk of the infantries of Europe has since been proceeding; and but for the prejudice against everything connected with the "line," which originated at Jena, the chances are that all would long since have gone over to our old Peninsular model many years ago. Indeed, in all but the name, they have actually done so, for the normal interval between skirmishers in the line attack formation gives everywhere rank entire, and in practice it has long become necessary to put a veto on the man's right of private selection.

Men are still taught everywhere to skirmish intelligently, and in Germany and Austria for years past everything possible has been done to educate and encourage individuality, precisely in accordance with the spirit of the old 52nd at Shorncliffe in 1803,[1] but when the real attack commences, the discipline in the fighting line is as rigid as possible, and all following reinforcements still move, where the ground permits, in the traditional old two-deep line.

But whilst these points were being thrashed out by the infantry, an improvement of incalculable importance had been made in the artillery.

In 1870 the Germans had only common shell, and not more than one battery in four had been trained to the modern methods of ranging. The uniform adoption of this system at once quadrupled the fire power of

[1] It is usual to credit Sir John Moore with the making of the Light Division at Shorncliffe Camp, but in a note to p. 68 "Historical Record of the Oxfordshire Light Infantry" I find that "letters from Sir John Moore are now extant which corroborate the assertion that the improved system of marching, platoon exercises, and drill were entirely Lieut.-Colonel (afterward Major-General) Kenneth Mackenzie's"

the batteries, and simultaneously the introduction of new guns with 1,500 feet a second initial velocity and a reliable shrapnel shell completely destroyed the existing conditions of the battle-field.

Where the power of the infantry arms had increased twofold at the outside, the power of the guns had multiplied at least twentyfold, and with the introduction of Q.F. guns the advantage became fortyfold.

It was only natural that the French, with their traditions of Senarmont and Drouet, should be the first to realise the full possibilities this change entails, and this explains their readiness to sacrifice many minor points in their equipment to secure the full advantages of the Q.F. system, and to be content with somewhat lower ballistic properties to gain the power of firing without relaying. For this at once placed them relatively on a par with the old case-shot attack in the early years of the century and facilitated the task of preparation in a corresponding degree.

Hitherto both French and Germans had counted on the slow degradation of their enemy's infantry fire by common (or H. E.) shell. This it was calculated would take considerable time and give ample warning of the point of attack, thus facilitating the movement of reinforcements; but realising the full possibilities of the new weapon, the French elected not to prepare, but to cover, the infantry advance by such a hail of shrapnel bullets that practically nothing the size of a man's head and shoulders could exist above the entrenchments long enough to take aim and live, and even if by chance it did, the dust and smoke of the bursting shells would deprive it of all objects to aim at—precisely the conditions we produced at Pieters Hill.

This settled the question of infantry attack formation once and for all; for against unaimed fire only the area exposed and the duration of exposure signify, for the reasons stated above. The sole condition is that when the artillery fire ceases, as at last it must, the infantry must be so disposed that every available rifle can be brought simultaneously to bear, and the "line" is the sole formation which satisfies this condition.

The decisive battle of the future, therefore, will unfold itself as follows:—The side which is first ready to strike must advance at once to catch its enemy while still in course of concentration, and the cavalry screen will play a more or less important part according as the country is more or less open—it is a convenience, not a necessity. If the enemy is caught whilst still on the march, entrenchments cannot well be formidable and the advantage is all with the strategic initiative; but if he is found already in position, then the task of fixing the details of his alignment must be carried out by infantry extended in the good old-fashioned light infantry style, twelve paces at least to the file.

This operation will need both time, and a high degree of trained tactical faculties on the part of all ranks, a degree which can only be attained by systematic instruction extending over a course of years; and I should, therefore, train the whole of our Regular infantry as light troops.

During this delay and on the information received, the commander fixes his point of attack and taking every advantage of cover, long lines of artillery are developed, and enter into action simultaneously (by rocket or balloon signal suggested).

There is obviously greater opportunity for an artillery surprise now, when the area for the selection of position covers a zone from 2,000 to 8,000 yards from the enemy's guns than in 1870, when it extended between 1,000 and 3,000 only, and it will be remembered that the long-range fire of even the Imperial French infantry, steadier by far in the early battles of the 1870 war than any modern conscripts, never succeeded in silencing a well-served Prussian battery, as long as its ammunition held out. Colonel Long's guns only ceased fire at Colenso when their ammunition was expended, and they were under a converging relatively close-range infantry fire.

On the artillery duel it is not necessary to dwell at length. One side or the other must get the upper hand eventually, and, whichever wins, its infantry must go forward to attack, to utilise the advantages gained; but since the advantages require only to be local, say, on a front of five miles out of thirty, the probability of success lies largely with the side that retains the strategic initiative, *i.e.*, with the assailant. This part of the action falls under the old Napoleonic formula: *On s'engage partout et on voit*; and, meanwhile, the infantry and artillery destined for the assault are being massed under cover of the woods and hollows from which no European battle-field three miles deep is ever likely to be free. The artillery, relieved from the pressure of the enemy's return fire and largely reinforced, gallop in to most effective shrapnel range, and as their infantry break cover, the whole of the defender's front is covered by a pall of smoke and dust, through which accurate-aimed fire is impossible. From time to time the fire is interrupted to tempt the enemy to put up their heads, and then renewed with full intensity, and, underneath the storm of shells, the infantry advance in a succession of "lines," breaking into line of company columns, or remaining in two-deep lines as the ground and circumstances demand; the essential being that when the artillery fire overhead ceases and the dust cloud sinks, every available rifle should be ready to take up the fire-fight with the opposing infantry. Then the best shooting, which will be a consequence of the best discipline and highest *moral*, will decide as it has always done, and the position fall to the bayonet-charge exactly as in the past.

But behind the enemy's ridge, reserves will also have been forming, and fresh troops thoroughly in hand, *i.e.*, in close order, must be available to take up the struggle. This is the moment when on either side the cavalry may play a decisive part, for concealed approach (better *unobserved* approach) is open to either, and our military bullets will no longer drop a horse dead in his tracks like the old 12-bore musket, a fact well known to every sportsman.

It is to take advantage of these moments that the German cavalry all carry lances, though their extra weight and general unsuitability for outpost duties are thoroughly well understood.

Briefly, from the Continental standpoint, the problem of the modern battle lies in the use of the reserves after the first position has been carried, not in the carrying, and this explains the importance they attach to close-order drill and precision of manœuvres.

To sum up the historical argument, *i.e.*, the result of experimental research:

In all periods both sides have striven to surround themselves with a barrier of fire sufficient to stop all direct assaults as long as the troops remained unshaken.

To shake and disorganise these troops has always required time, which time could and can be utilised to move up troops for use in all contingencies.

As between two equally armed infantries this task of shaking the adversary has always been a long and bloody business, but experience has shown that in open ground the surest way was to get as close to the enemy as possible, consistent with the maintenance of fire control, and then overwhelm him with every musket which could find room in the fighting line. Fontenoy and Quebec are the classic instances of this method. At the former the first volley of the British Guards is alleged to have swept away 690 of its opponents, and at Wolfe's last fight on the Heights of Abraham the "perfect volley" which opened the action practically decided it.

When the ground permitted, the combination of cavalry with infantry obtained the greatest results in the shortest time, and at the least cost to the victor.

The tactics of the French Revolutionary levies, afterwards adopted by all Europe, had their origin in social changes and marked relapse—not progress in military evolution. Infantry other than British were no longer good enough to fight out a battle to a decisive finish; and but for the evolution of mobile artillery, attack and defence would have balanced one another. All this time, from 1740 to 1840, there was no essential change in armament, though the casualty lists show extraordinary variations.

The invention of the long-range rifle eliminated the use of artillery for case-shot preparation, and immediately battles became as severe as of old, though the rate of fire possible was materially reduced.

In 1866, in spite of the increased rate of fire, on one side the casualties were markedly lower.

In 1870 the worst armed infantry was victorious, but the losses in the bloodiest battle only came to 2·5 per cent. per hour.

In 1877 the worst armed infantry again ultimately proved victorious (the Krnka rifle being almost, if not quite, as outclassed by the Peabody-Henry as the needle-gun by the Chassepot); the slaughter again did not equal the standard of former days.

Neither in the Zulu War, in Egypt, nor in Afghanistan have Martinis or Lee-Metfords inflicted equal slaughter on similar targets as the old muzzle-loaders in French hands in Egypt and Syria, or in British hands at Meanee and Hyderabad. At Meanee every musket on the ground killed three and wounded six in three hours.

In South Africa the percentages of killed and wounded have been the lowest ever recorded in warfare between two equally stubborn antagonists, equally well armed.

On these grounds, foreign authorities have everywhere come to the conclusion that, with equal arms, losses are practically independent of the nature of the weapon, but are mainly conditioned by the skill of the leader in his choice of the moment for attack, and the means at his disposal for the execution of the act of preparation. Where time is not the governing factor in his decision, it is in his power to suit his choice to the quality of his troops, and not to send them into the assault until the enemy's fire is so far reduced that the losses to be anticipated will not exceed his estimate of the endurance of his men.

The introduction of shrapnel and of Q.F. guns has actually placed the power of artillery relatively to infantry in a more favourable position than in the case-shot days. For not only can a Q.F. gun throw an equal number of bullets per minute (bullets which do not scatter till well up to their target), but owing to the greatly increased range the fire of ten times the number of guns can be concentrated on any one point of the defender's lines, and, thanks to this power, it is considered probable that the assault of a position will no longer decide a battle, but that the decision will depend upon the perfect discipline of the men and the personal initiative of officers in the struggle which must ensue within the enemy's position, for which no rules can be given. Cavalry will find their full opportunities against each other and demoralised infantry precisely as in the past.

Generally, increase of range in the infantry weapon, by facilitating the concentration of fire on any point, whether in the flank or centre, has very materially added to the advantages of the assailant, and to strengthen all the above arguments add the demonstration given above: that the risk of being hit in the passages of a fire-swept zone of ground is actually less, not greater, than in the past, and the argument, in favour of training troops to fight under the strict control of their leaders, *i.e.*, in close order, has been enormously reinforced.

APPENDIX.

Calculation to show the best formation for a battalion to advance across an open glacis.

It is assumed that in order to establish a fire superiority preliminarily to an assault, a battalion (under cover) receives orders to seize a ridge 400 yards nearer to the enemy, and for this purpose has to cross an open slope swept by the enemy's fire with a uniform intensity which will place two men out of action per minute of exposure, on every 200 paces of front, the men being deployed in single rank. Find the formation that will entail least loss on the attacking troops.

The problem is almost identical in character to that solved by the 38th Brigade in the battle of Mars-la-Tour.

The fire being assumed uniform in dispersion, then if four hits a minute are scored on 200 men occupying in single rank 200 paces, then only two hits per minute would strike 100 men extended at four paces interval, or one hit in two minutes if at eight paces interval. If in two-deep line, then each hit may be taken as disposing of two men; in in three-deep line, then of three.

For the purpose of this investigation, it is further assumed, that not less than 300 rifles are required on the ridge to beat down the enemy's fire; less than that number will be overpowered by him.

The distance being 400 yards, the time required to traverse it will be four minutes.

In that time a three-deep line, 600 strong, would by hypothesis lose $4 \times 12 = 48$ men, reaching its firing position with 552 rifles, who would be most inconveniently crowded.

A two-deep line would loss 32, and with 368 rifles would very closely fulfil the requirements, and be able at once to hold and beat down the enemy's fire.

Single rank would lose 16 out of 200 men, and would at once require reinforcing.

Assuming, to simplify the calculation, that owing to high crops, the men have to fire standing, then if their support follows 200 yards behind, two minutes will elapse before it can reach t'. m, and in that time 168 men already on the ridge will lose an additional 12 men, and their reinforcement starting 200 strong will also lose on the way up, which entails four minutes' exposure, as many men, viz., 32, as the line before it, so that after two minutes there will be 324 rifles in action, *i.e.*, 44 less than the two-deep line could dispose of simultaneously.

With men extended at four paces interval, *i.e.*, 100 men to the whole front of 200 paces, 16 men would drop in the advance and 3 whilst waiting for the next support, which also loosing 16 by the way would bring the total number of rifles up to 165, in two minutes. Similarly, a third line at the same distance would bring the numbers up to 241, and it would require a fourth to bring it up to 316, in eight minutes; showing a loss of 84 men against 32 and 72 respectively of the former ones.

Proceeding in the same way, 50 men at eight paces would lose 8 men in their advance, and allowing for losses incurred by the firing line whilst waiting for their reinforcements, it would require 14 minutes to bring 312 rifles out of 400 to the required position.

The losses, therefore, would be in the following order: line, 64; single rank, 72; 2 paces extension, 84; 4 paces, 88; three-deep line, 96. But the percentages would be: three-deep line, 16; two-deep, 16; single rank, 18; 2 paces extension, 21; 4 paces extension, 22.

Next take a distance to be covered of 600 yards, all other conditions remaining the same, by the same method the results work out :—

Formation.	Loss.	Percentage.
Three-deep line	48	24
Two-	32	24
Single rank, requires two reinforcements = 600 men to exceed 300 rifles	181	30
Two paces extension, 5 reinforcements = 500 men in 10 minutes	147	29
Four paces extension, 9 reinforcements = 450 men in 18 minutes	145	32

For 800 yards the result is even worse for the extended lines, and the whole investigation proves, to my mind, conclusively what I have always maintained, viz., that of all "battle" formations, the "line" is the most economical of human life and the one best adapted to meet all emergencies.

We have only to suppose a counter-attack developing unseen behind the ridge, as was the case at Mars-la-Tour, to see how far stronger for immediate resistance the line with its 304 or 336 rifles available would be than any of the other formations submitted.

Moreover, it is an admitted fact founded on the experience of years, that troops in close order will stand up to heavier punishment than troops extended, and here the line requires them only to stand from 16 to 24 per cent., a low rate according to the old standards, against the 30 per cent. demanded from the extended formation, a rate which they certainly never have faced in the past.

The argument, of course, holds good whatever the intensity of the enemy's fire. I have chosen the above figures simply for facility of calculation.

Major-General C. E. WEBBER, C.B., *p.s.c.* (Ret. R.E.):—I have just a few words to say in connection with this most interesting paper. Its whole tenour appears to me to lead up to the one contention in the last part, namely, that the movement of troops within the zone of fire must be most advantageously effected in a line formation, in close order, in two ranks—what the speaker calls the British line. If he is right, there is no doubt he has taken our minds back to a condition of things under which we can study the battle of the past with quite as much advantage as we can study the questions that have been emphatically brought before us lately in South Africa. In his example he refers to a body of 400 infantry who have to move a distance of 400 yards from a position where they are under cover to a ridge which intervenes between them and the defenders—whose locality is not given to us—but whose distance may be estimated by the hypothesis of the effective fire which sweeps the area over which the 400 men have to advance. It is that the effective measure of the defenders' fire is 8 casualties per minute in 200 men in a single line in close order. Anyone can picture the conditions to themselves. You are defending a position, and between you and the attacking force which before it advances is under cover there is a ridge which this attacking force is called upon to occupy. In advancing from their position of cover to the ridge the 400 attackers have to cross the zone of your fire. The intervening space is described as a glacis. I am not going into the question of the 400 yards a minute, but let us accept that figure. Then we are told that if the 400 men in two ranks of 200 men in each, in close order reach the ridge in four minutes, they will have suffered 64 casualties, that is to say, 32 in each rank; each hit will put two men out of action one in each rank. The next example which he gives us is that of the 400 men advancing in two single ranks of 200 each with an interval, which I think he would say that he means to be one of two minutes, which would mean that the 400 men would reach the ridge in six minutes, and then he says the casualties would be 72. I am not quite sure whether it is 72 in four minutes or 72 in six minutes?

Lieut.-Colonel MAUDE:—Six minutes.

Major-General WEBBER:—Then take the next case in which these 400 men advance in four lines of 100 each at one pace interval between the men, starting from their position of cover at intervals of two minutes. They would reach the ridge in ten minutes, and the losses in that time, according to Colonel Maude, would be—What?

Lieut.-Colonel MAUDE :—84.

Major-General WEBBER:—Then Colonel Maude gives you a fourth case in which these 400 men would advance through that zone of fire, over that glacis, in eight lines of 50 at two paces intervals, starting at intervals of two minutes between each line. They would take eighteen minutes to get there. In that eighteen minutes they would have lost—How many ?

Lieut.-Colonel MAUDE :—88.

Major-General WEBBER: – I cannot conceive it is what would happen, and, therefore, I do not think that Colonel Maude's example is a practical one. In each of his examples no individual man is more than four minutes under fire. In the first, you will have to keep up your fire on him during six minutes. In the second and third, during ten and eighteen minutes respectively. The object of this advance in Colonel Maude's example is to get 400 men as quickly as possible into a new position. If instead of with two minutes, he were to start them in the second case at one minute interval, the four ranks would be 100 yards apart and the last rank would have arrived at the new position in seven minutes ; and in the third case, if at half a minute, the eight ranks would be 50 yards apart, and the movement would have been accomplished in seven and a half minutes. In the same case with a quarter minute interval, it would be over in five and three quarter minutes. It seems to me, that, the only justification for Colonel Maude's theories is this : that if 400 men in their advance have to traverse a fire zone with an equal and constant density of projectiles, they will have the fewer casualties irrespective of their formation the less the interval of line between the moment of advance of the first and the arrival in the new position of the last man. This is no true argument, I submit, in favour of *line* formation, which distinctly means shoulder to shoulder, touch to touch, a formation which entails slower movement, and therefore the longer time spent in the fire zone. All it means is, that, in whatever kind of rank and at whatever intervals the movement is made, it shall not be made with such speed as will produce a tailing off into lines coincident with the direction of your fire.

Captain STEWART L. MURRAY (Gordon Highlanders) :—I think that the lecture which Colonel Maude has given us to-day is a very valuable one, as it breaks ground on a subject which will be discussed a great deal in the near future ; and also because it will give what I consider a much-needed warning to the extremists not to be too certain that they are absolutely correct in their, perhaps, premature deductions from this war. We all know what these extremists are. I remember some years ago, before the war, they used to say, "Oh, what is the good of bothering about what the foreigners are thinking, for we shall never have to fight a European enemy." And now no doubt we shall hear them say, "Oh, what is the good of bothering about what the foreigners think, for they have not been in South Africa." Now, as regards the so-called "lessons" of the war. A great many civilians, press correspondents, and even some officers, appear to think that these "lessons" are absolutely new. That, of course, is not the case. Most of these so-called lessons of the war were known before the war began, and are to be found in the more advanced books on tactics, which a great many people appear to have forgotten. In such books, for instance, as Hoenig's "Tactics of the Future," written some years before the war, most of the so-called new features of the war are to be found fully discussed. Here are to be found such things as the use of advanced invisible positions : the consequent difficulty of reconnaissance, as cavalry cannot get near enough to be able to make out the main position with the naked eye ; the impossibility of thus finding out by reconnaissance more than the position of the

enemy's flanks, and the necessity of finding out further information by fighting; the added strength of the defence, and the consequent ability to hold a position with fewer men, thus increasing the number held back for counter-attacks; the impossibility of volleys under modern fire, and the consequent necessity for careful training in controlled independent fire; the inevitableness of a mixture of units, and of training the troops to fight with mixed units; the difficulty of command and the necessity of training men to pass the words of command down the line, etc; the use of low invisible shelter-trenches with head-cover and splinter-proofs, in which men could remain invulnerable to artillery fire till wanted. All these so-called new features of war had been foreseen and discussed by Continental tacticians, and the present Continental tactics are drawn up by men fully acquainted with these questions. It seems to me that the only thing Continental tacticians have not taken fully into account is, what everybody who has come back from the war tells us is, perhaps, the most important point of all, namely, the tremendous and moral effect produced by fighting against an invisible enemy, and having to fire against an enemy whom you could neither see, nor locate, nor fix as to range. With the exception of this very important point, it seems to me that Continental tactics are based very much on what we know now. Such tactics were not applicable to South Africa, no doubt, owing to circumstances, to the peculiar nature of the enemy, the country, and the climatic conditions. But it by no means follows that they are not applicable to the country for which they have been specially thought out, namely, Europe. Let us not make the logical mistake of arguing from the particular to the universal. Don't let us be in a hurry to dogmatise. *Festina lente.* Now, as to the frontal attacks. A great many people say that frontal attacks have been proved to be an impossibility. But that is merely wild talk, and objection must be taken to it. I say that the frontal attacks which have been proved to be impossible are really only such attacks as foreigners would call regimental attacks, what we call brigade attacks, with three or four battalions, *not* divisional attacks, not army corps attacks, not attacks with great numbers of troops such as Continental tactics are based on. It was perfectly well known after 1877 that regimental attacks, with three or four battalions, could not hope to succeed against entrenched positions, every such regimental attack in 1877 entirely failing, such as the regimental attacks on the Grivitza redoubt, or the twenty-four battalions who tried to take the Omar Bey Tabya in a series of regimental attacks. The men got close to the trenches, and in some cases on to the trenches, but were then driven back for want of sufficient lines following in support. If those twenty-four battalions had been employed simultaneously on Skobeleff's principles they would have succeeded. I thought it was after 1877 an accepted axiom that it was no good attacking entrenched positions with only three or four battalions, a foreign regiment or British brigade. In this war we have tried that same thing again and again, and it has failed, as everybody said such attacks must fail. That lesson of 1877 has been retaught. But it is not a new lesson. But I submit there has been no instance of such an attack as Skobeleff's attacks failing in this war. Every position he was ordered to take he took, because he never made regimental attacks. He never attacked with less than sixteen battalions line behind line, on a narrow frontage and with great depth. In his attack on the Green Hills his first line of two regiments (or British brigades) in three lines, I think, was brought to a standstill at 500 yards; he then reinforced with fifteen companies, who carried the line on to 300 yards and were brought to a standstill; he then reinforced with twenty companies, who carried the line on to 150 yards, and were stopped; he then placed himself with

some reserves at the head and captured the trenches. But how would his first two regiments have fared if they had not been so strongly reinforced? They would have failed of course. But Skobeleff knew better than to waste his forces piecemeal. In his attack on the Scheinovo entrenchments he had, I think, sixteen or seventeen battalions. First came two rifle battalions in front, then another battalion; then the Ugla Regiment, each battalion in two lines at 380 yards distance, total depth of Ugla Regiment 2,000 yards (*i.e.*, the second line of our Drill Book), and the Kasan Regiment followed the Ugla Regiment; and he took the position without artillery preparation or covering fire, except one mule battery, I believe. The point I want to make is this, that it is not fair or correct to say that these Continental attacks with masses of troops cannot succeed in future war, because they have not been tried in this war. They succeeded in 1877 against the tremendous hail of bullets poured on to the ground over which they advanced by the Turkish quick-fire. The only frontal attacks which have been tried and have failed are those which also failed in 1877, namely, regimental attacks. We only failed where the Russians failed. We should have succeeded, I firmly believe, in attacks made as Skobeleff made them, if we had had enough men to try them, and they had been necessary. There is another point which a great many people talk about, and that is flank attacks. People say that you must never attack in front, but always work round the flanks. That is all very well in some cases, but it won't do for all. To begin with, if you want to hold the enemy to his position while your flank attack comes off you must make a frontal attack. And every flank attack itself must end in a frontal attack for the troops who make it. The only difference is the difference between a frontal attack on an entrenched position and one which is not entrenched or only slightly entrenched. And, therefore, as far as the troops are concerned, and their training, the only thing to consider is how a frontal attack can best be carried out. I think this is a point which requires to be pressed, for you hear civilians abusing every frontal attack as if it were a frightful crime to make one. Whereas every attack must, to the troops engaged, be a frontal attack. To avoid misconception I would wish to state that I do not, of course, for a moment deny that there are many most valuable lessons to be learnt from South Africa, only these lessons are chiefly lessons relating to detachment fights, and do not so much affect the tactics of pitched battles, which is what Continental tactics deal with. And, as everybody knows, there is a great difference between the tactics most suited to detachment fights, and those most suited to obtain decisive results in a pitched battle. As regards these Continental tactics of how best to make use of masses of troops, I have seen in the newspapers most severe criticisms, accusing foreign officers of ignorance of the effect of fire, and all kinds of things, which, of course, is absurd. The point I wish to press is that these tactics are adopted after full consideration of all the so-called lessons of war, with the single exception perhaps of a full appreciation of the moral effect of fighting against an invisible enemy. If we examine them critically, therefore, we must not assume that foreign officers are ignorant of the effects of fire, or any other material factor of the modern battle-field, all of which we know they have exhaustively studied. These tactics should be regarded from the standpoint of what modifications, if any, are rendered necessary owing to the new moral factor which has been so strongly brought out in South Africa. I think it is very probable that they have themselves seriously considered this new factor, and are preparing the consequent modifications, such as, perhaps, that the assault shall be postponed till the close of the day, when the gathering dusk will

render it easier, etc. But if so, this modification would not be apparent at Continental manœuvres, for there the attacks have to be hurried over in haste and finished early, so that the troops may get back to their billets. So we must be cautious, and not make too hasty judgments on foreign tactics as displayed hastily at foreign manœuvres. I wish to again press the point that the only frontal attacks made in South Africa were regimental, or, as we should say, brigade attacks, which 1877 had already demonstrated to be too weak to carry an entrenched position. Their failure is, therefore, no new lesson, but only the repetition of an old one. It proves, however, as Skobeleff proved, that attacks on entrenched positions must not be less than divisional attacks to have a chance of succeeding. The lesson is, that if we have not enough men for such attacks by sixteen or twenty battalions, then we must get them, *i.e.*, we must have universal service. I consider that the lesson points to the fact that for European warfare we must have great numbers of troops available for attack, which numbers can only be obtained in one way. As regards the actual conclusions of the lecture, I think we owe great thanks to Colonel Maude for so ably putting the mathematical theory of the attack before us for consideration. But in every case, after laying down the theory of the matter, we have to make the necessary allowance for human nature—the material with which we deal. Therefore, I think single rank, a loose single rank, is necessary, for the actual firing line—for I believe a double rank would at once become an overcrowded single rank. I think his conclusion is more applicable to the advance under unaimed fire of the troops of the second line for the actual assault at the close of the day, possibly in the dusk of the evening. But the whole question raised by this lecture requires the deepest and most prolonged consideration, which it will doubtless receive. And it is extremely valuable as a warning against too hasty generalisations from the detachment fights of South African warfare to the tactics of pitched battles in Europe. And the application of the matter of this lecture to ourselves is this:—If our fleet is ever defeated, or, after perhaps a drawn battle, has to return to port to refit, if we are ever invaded, the military problem before us will be the following: Three army corps entrenched on our shores, while the great liners which brought them hurry back for more. In a week three more or so will have reinforced the first three. In another week three more will reinforce those six. Both France and Germany have ample transport in great liners for this. Our problem will be how to overwhelm those first three or six army corps before they are reinforced by more. That is to say, that what we have to consider in this country for home defence is the problem of pitched battles. The commercial and industrial conditions of this country are such as would render a prolonged campaign an impossibility. We must take the offensive in overwhelming strength—two to one—for a pitched battle. Our military problem is how to get the requisite number of men of discipline and training fit to attack European troops in an entrenched position in a pitched battle for our existence. We have not got them at present, and the sooner we get them the better.

The CHAIRMAN (Major-General H. M. Bengough, C.B., *p.s.c.*):—It is quite possible that there are many here to whom Colonel Maude is familiar in his literary capacity, though not known to them personally. It is only quite recently that I had the pleasure of making his acquaintance, through the fortunate accident of an introduction by a common friend; but I am well acquainted with his writings. A good many years ago, when I was captain of my regiment in India, I came across a report of the lecturer's—then Captain Maude of the Engineers—on some cavalry manœuvres in Germany; and I was very much impressed by the thoroughness and grasp of the subject, and the acquaintance that the author showed with an arm of the

Service not his own. As you will remember, in those days it was considered an intrusion, if not an impertinence, to attempt to pretend to any knowledge of any arm of the Service outside your own. This characteristic of thoroughness Colonel Maude has always exhibited in his writings. We all agree that we have had a very valuable paper, rather a difficult paper, perhaps, to get at. It seems to me a little doubtful as to how far it is possible to prove theories on the science of war by mathematical formulæ, the science of war being so much based on moral principles and dealing with human flesh and blood. But they are exceedingly interesting, and serve to show the great care with which Colonel Maude has prepared his paper. The paper seems to strike in different directions. I do not propose to follow General Webber in the intricacies of explaining these problems. But it seems to me that the point to which Captain Stewart Murray directed his attention is most useful. There is no doubt that we have learnt many lessons from the war, but with these useful lessons there are mixed up a great number of fallacies—I might almost say heresies—which have crept into the extremist views which Captain Stewart Murray referred to. I will review briefly one or two of these which appear to me to be specially refuted by Colonel Maude's paper. Our friend, the question of attack and defence, is a very old one, as old as primeval man. Now it seems to be decided, that the improvements of modern weapons, entrenchments, and barbed wire—I did not know that barbed wire was a recent invention!—have made attacking a position impossible. Much may be said on this question, but I would ask you to examine one or two simple considerations only. If it is true that the defence has benefited so much by effective fire as to be able to hold a long line with a small number of men, surely it is equally true that the attack in the same way can hold or contain an enemy with a small number of men, thereby being able to throw a larger number at any given point in the line, or turn a flank. With regard to the effective fire of modern rifles, Colonel Maude has shown that the casualties in the present war have been considerably less than in the Seven Years' War, or Napoleonic period. In the same way with regard to the weapon of 1870, the Germans had an inferior weapon, and they were able to take positions by assault from the French, who were equally brave soldiers. In the Turko-Russian War the same thing occurred. We have experienced the same ourselves in this campaign, our own troops having in no less than five general actions successfully carried out an assault. Therefore I think we may fairly say that the attack has still some legs to stand on, and I hope that so long as the British Army lasts those tactics will be employed. Then comes the popular fallacy to the effect that a trained Army is no longer required by Imperial needs, and that a civilian Army is equal to all our requirements. That seems to hardly need any refutation, if it were not supported by such respectable authorities as Dr. Conan Doyle and our much-lamented friend—speaking in this Institution—M. de Bloch, whose excellent paper was only recently read at this Institution. It seems that this idea has gained ground from a few unfortunate incidents that happened to our Regular troops early in the war, compared with the excellent work carried out by the Volunteer troops. I am sure we soldiers are the first to allow every possible credit to the Volunteer troops for their admirable and gallant behaviour in South Africa. In to-day's paper I notice the mention of the New Zealand Horse, Scottish Horse, and South African Horse, who have performed some excellent work. Allowing all this very willingly, it must be said still that any civilian Army, any untrained Army, must be wanting in that great bond of union, that power of self-subjection for the general good which we call discipline, and where discipline is wanting all other military virtues will be of little avail. You will remember that the foreign officers who fought

in the Boer ranks largely bemoaned the want of initiative in the Boer Army, which they said was due to the absolute want of discipline amongst the Boers. Passing on to a third fallacy, which, I am sorry to say, some of the members of the Army seem to support, I would speak of the cavalry arm. People say now that the Regular cavalry is an arm of the past, and expect the cavalry soldier soon to be as extinct as the dodo. I do not think many officers who are in a position to judge would quite agree with that. I have no doubt our cavalry will require changes in their training, in their shooting, and in their equipment; but, when all that is said, I believe Colonel Maude, who is a strong advocate for the cavalry arm, will say there is still a future for well-led and well-trained cavalry. Lastly, I may mention the artillery. That is an arm from which we expected very great things during the war. It has not altogether fulfilled our expectations, not from any want of energy on the part of the arm itself. It is said now that artillery is unable to maintain an effective fire on troops in entrenchments, and to subdue the fire of those troops, and, therefore, is of no further use for preparing for an infantry assault. Some of you may have been present at a lecture by M. de Bloch a short time ago, when General Sir Frederick Maurice presided, when this point was mentioned by M. de Bloch, and General Maurice said :—"Yes, but let us remember that if guns are not able to turn troops out of trenches, if they can by a shower of shrapnel keep the troops in the trenches, preventing them from making use of their rifles, and thus enabling the attacking party to advance, they will be doing very useful work. Let us remember that our field artillery was undoubtedly outclassed during the war. When properly used, as at Pieter's Hill, they almost decided the action." I have not the honour of being an artilleryman, but I look in the future to the use of vertical fire as a very important adjunct to our Army. I think a 5-inch howitzer shell dropped among the Boers in their trenches would have somewhat disturbed their very cleverly designed domestic arrangements. You will, I am sure, authorise me to assure Colonel Maude of your appreciation of his clever and valuable paper.

Lieut.-Colonel MAUDE, in reply, said:—With regard to the losses of the line mentioned by General Webber, the distance of 200 yards in two minutes was taken simply as an example, and from the ordinary Continental practice. I had no particular reason to take that distance more than another. But if you halve that distance, as General Webber rightly points out, you will diminish the loss, and by halving it again you diminish the loss still more. If you can go on until the ranks come close together you practically wipe out all the extra losses, except those due to the bullets that may go through two men. I made the assumption that every bullet would go through two men, but it is not always the case; as the men fall, the line approximates to single rank, and a correction is due under this head. Besides, a great deal of the fire we should have to encounter would be shrapnel, which would not take two men. I was more than surprised myself at the result being so favourable. My contention for several years has been that what we wanted to do from the very beginning was to go back to what our forefathers learned before us, and remember that there were wars before 1870. I maintain that if we had only taken the Peninsular War as our model, multiplying the distances then used roughly by ten right through, we should have attained almost at once to an ideal form of infantry attack. As far as the exceedingly inferior rifles and muskets then in use would allow, they did make very good shooting, and there can be no doubt the effect of their fire was perfectly appalling. There is nothing in modern war to approach it. I have worked that out ever since General Beugough first remembers my taking the question up, and my one

object has been to see the good old British line restored to its place. Our war-trained troops did not find it stiff or unmanageable. With regard to what Captain Stewart Murray says, we are so entirely in agreement, that there is little I need say on the points he raises. He calls attention to the moral effect of a fire from an invisible enemy. No doubt that is very bad, but it was very bad in 1870 too, and also in the Turkish War, because the ranges were nearly as extreme. I do not think it matters much to a man who is hit when behind a hill by an enemy he cannot see, whether the enemy is 500 yards off or 1,500, but the number killed in long-range firing has not been excessive hitherto.

DIAGRAM SHEWING

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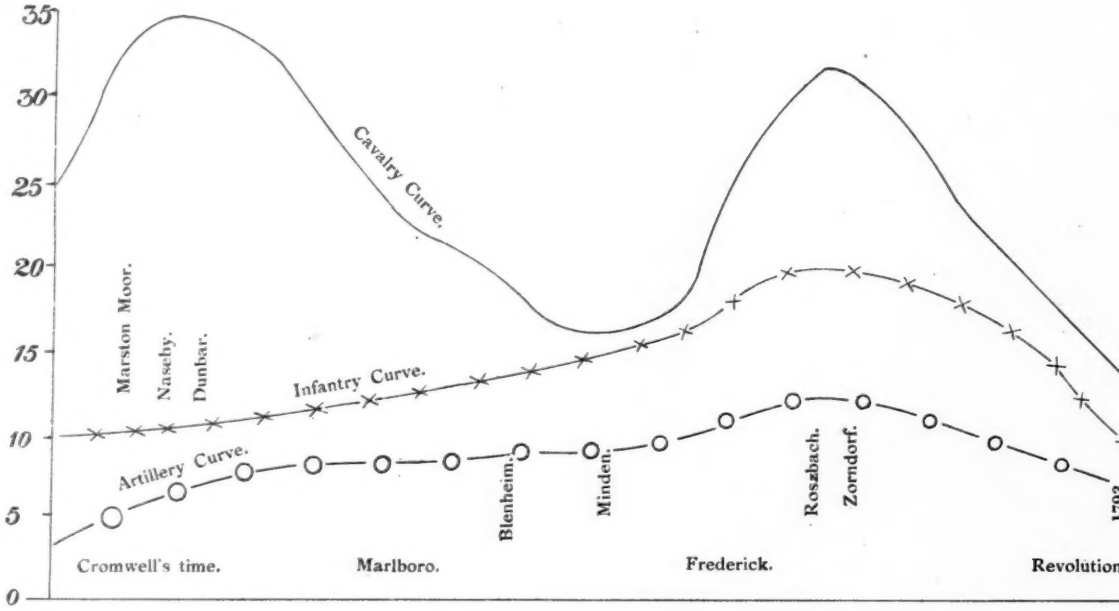

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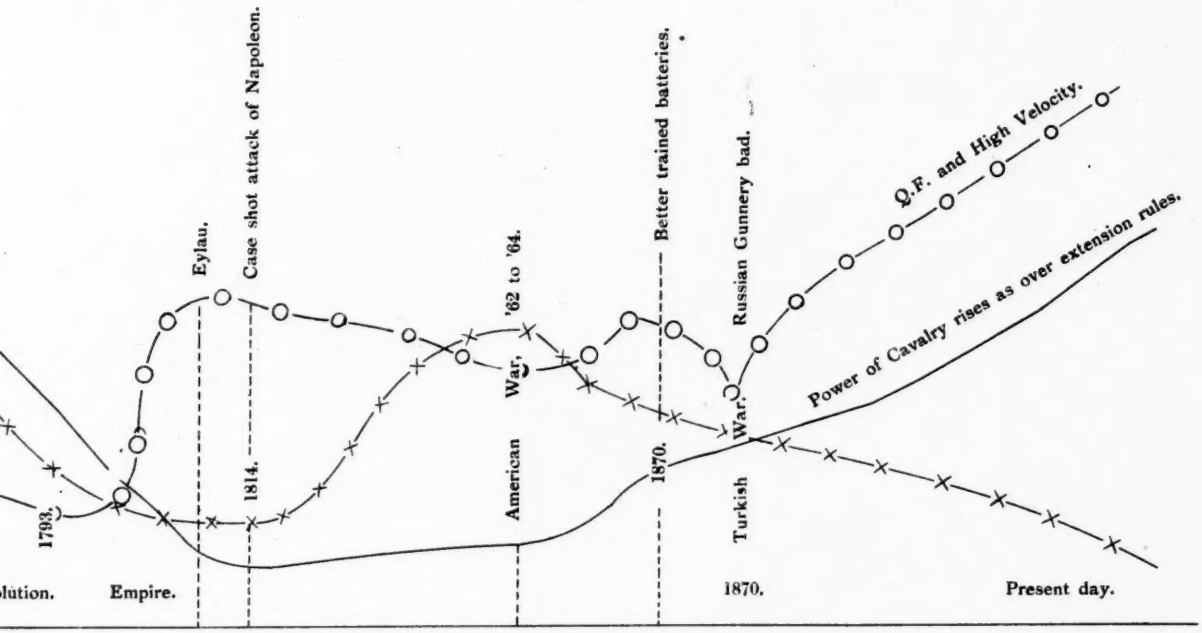

Decline of Cavalry due to want of training and exhaustion of horse supply.

DIAGRAM SHEWING FULL LINE RATE
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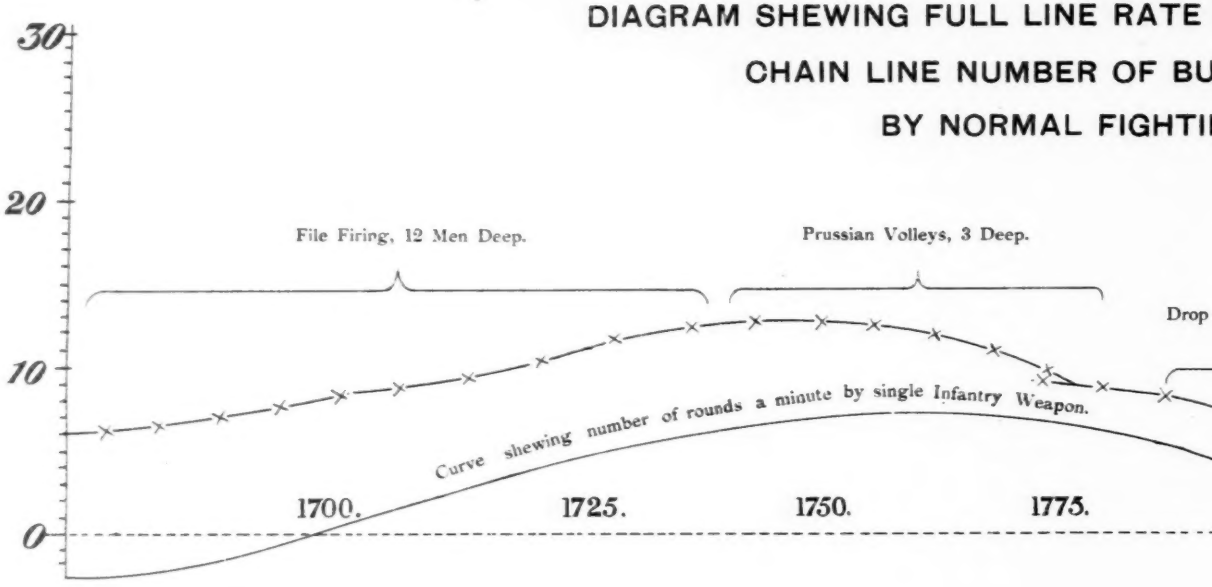

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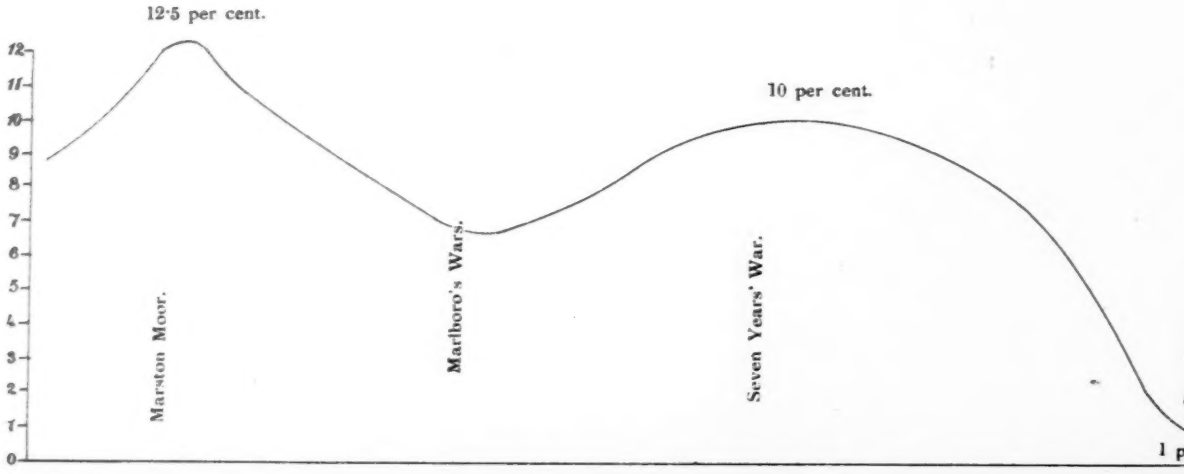

TE OF FIRE OF WEAPONS INDIVIDUALLY.

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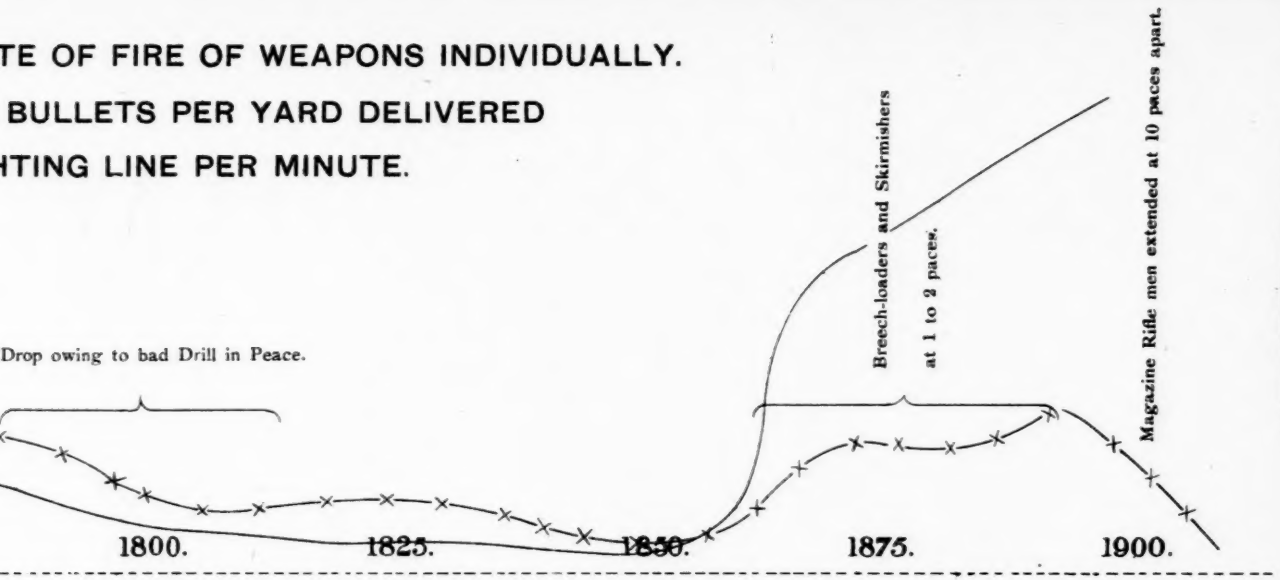
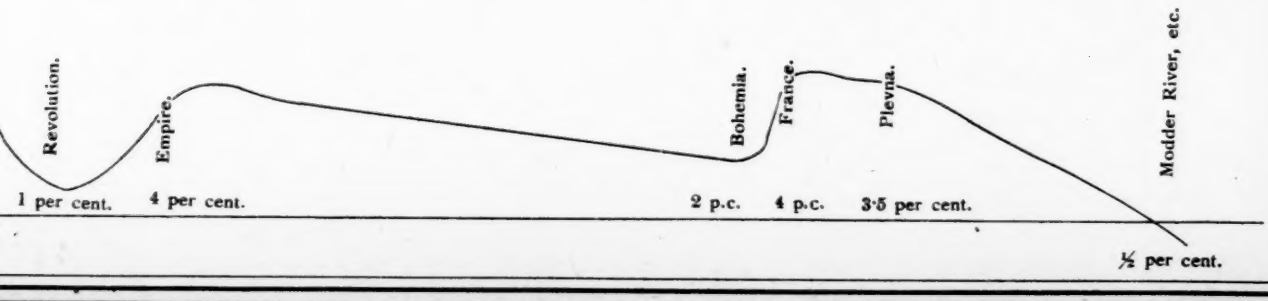


R HOUR AT VARIOUS PERIODS

L INFANTRY BATTLES.



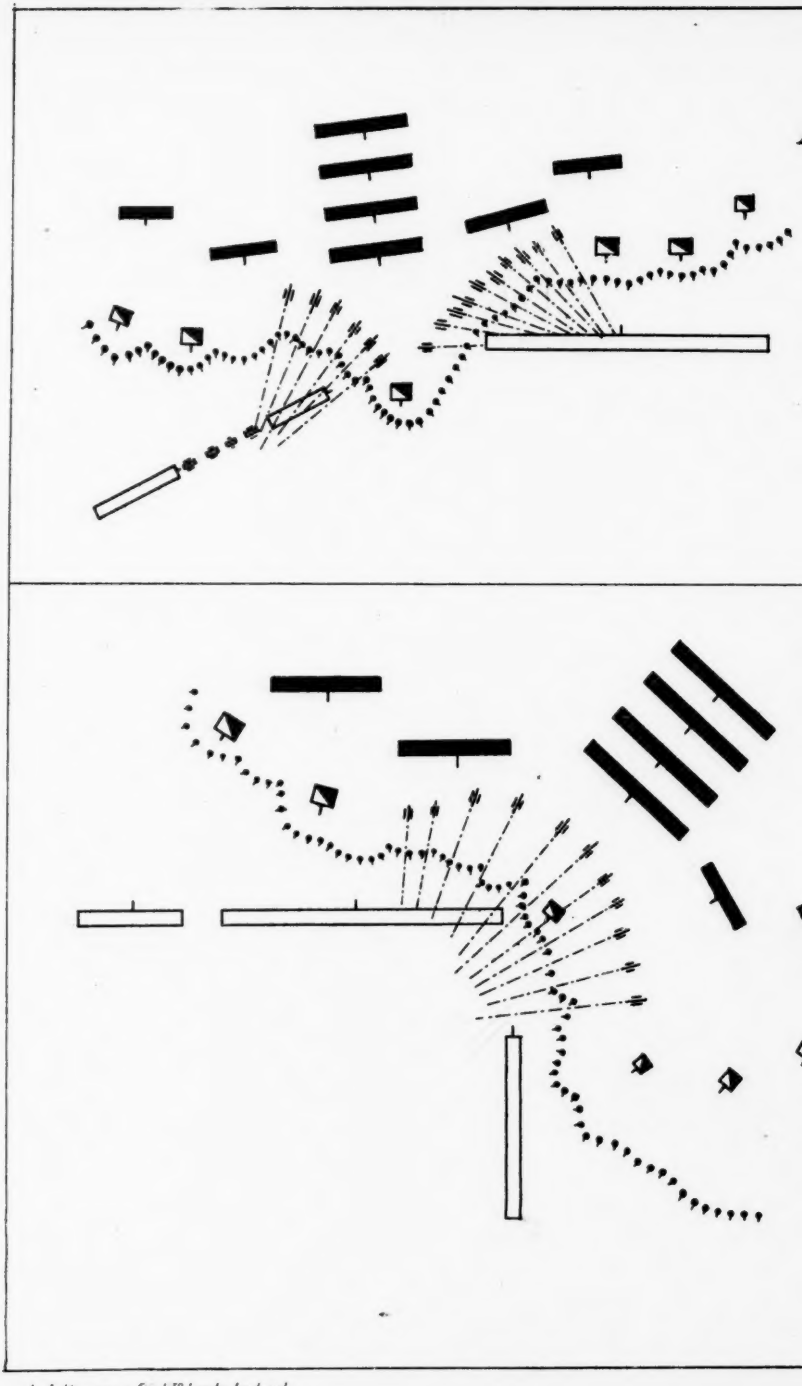


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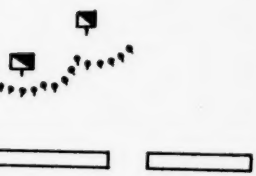
Fig. 1.



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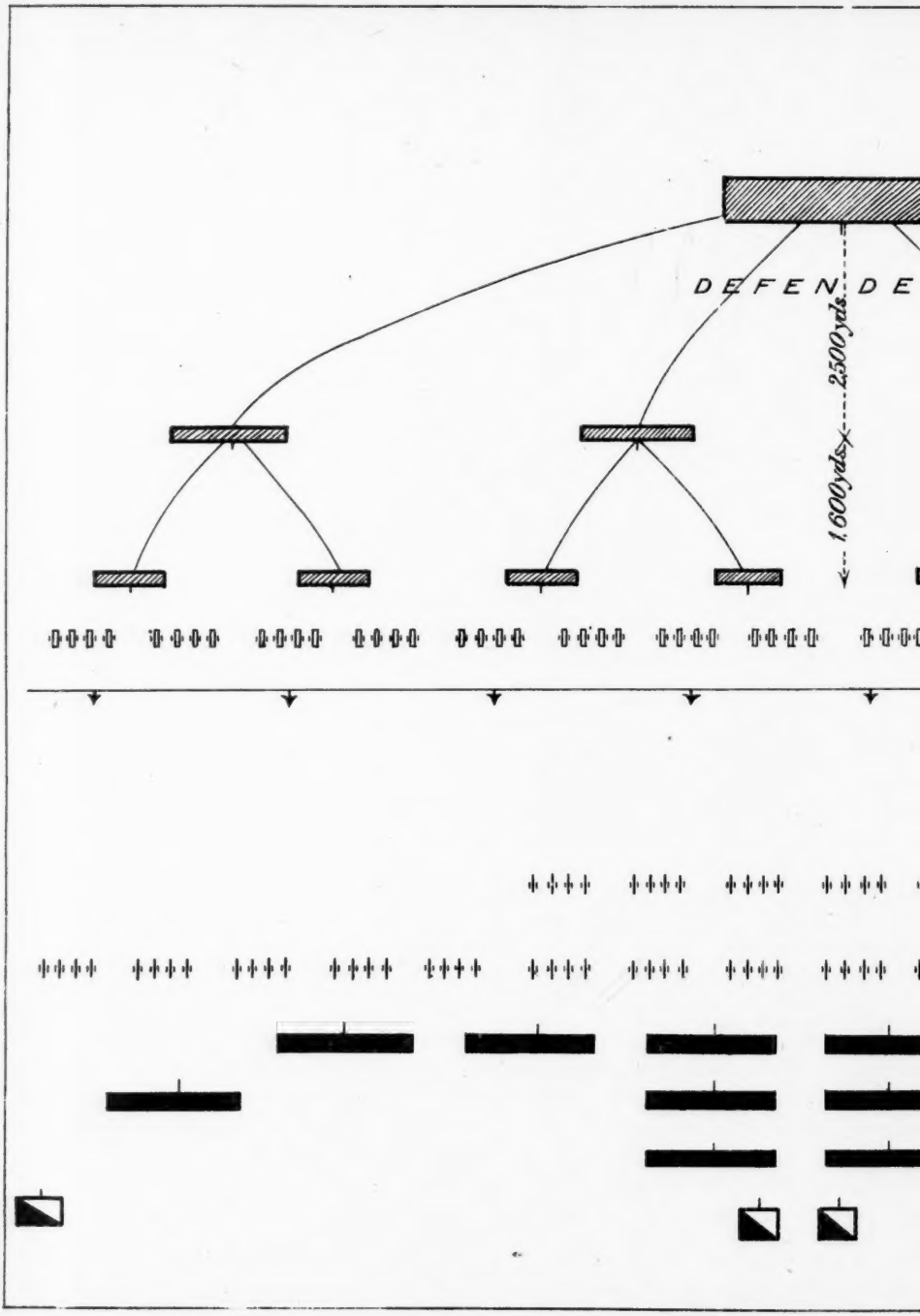

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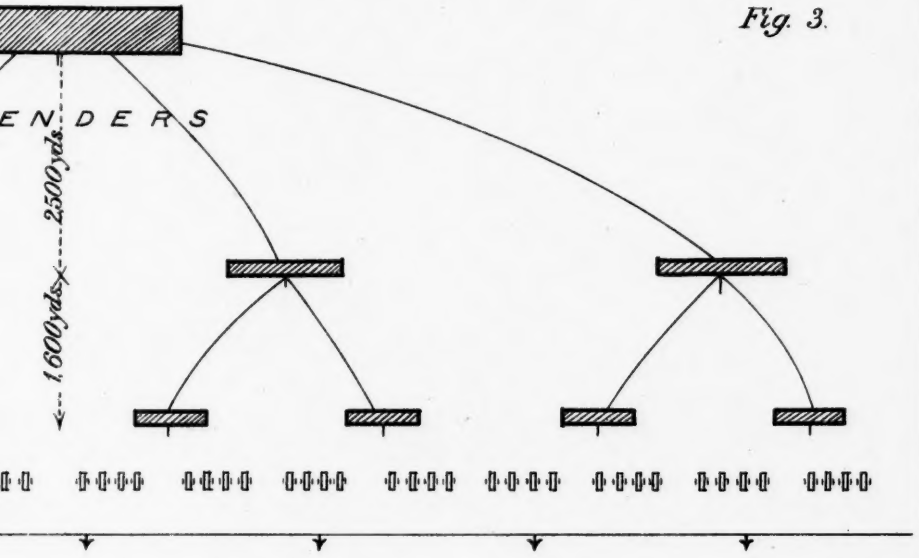
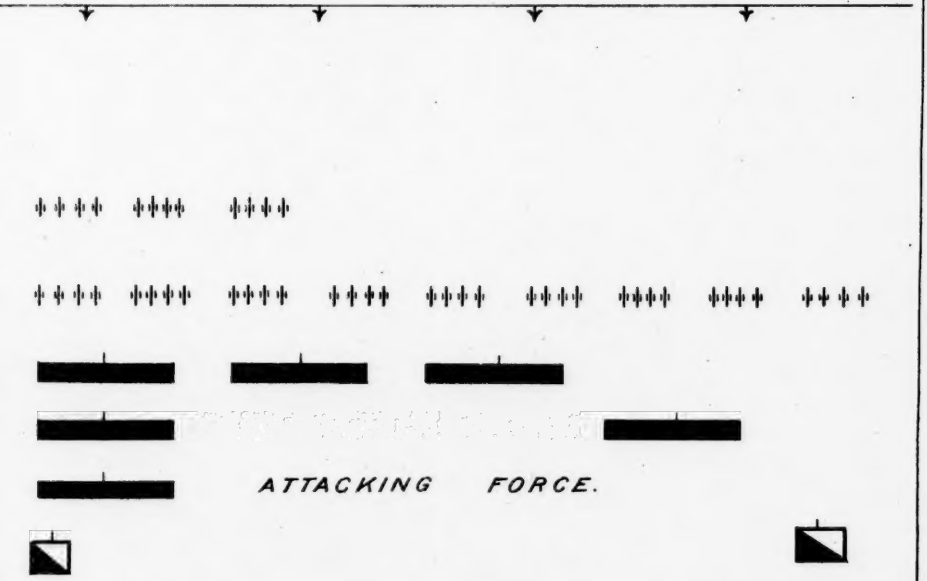
Fig. 3.





ATTACKING FORCE.

MILITARY OBSERVATIONS ON THE WAR IN SOUTH AFRICA.

Translated, by permission, from the "Militär-Wochenblatt," Beiheft 8, 1901.

Continued from February JOURNAL, page 226.

[*These observations on the South African War, sent to us by a German who took part in it, are published here on account of the Military lessons which may be derived from them.*]

The British infantry, as a rule, deployed for attack under cover of their own guns, and the formation adopted was very similar to that employed by us in peace manœuvres. When within range of effective rifle fire one saw nothing but widely-extended firing lines. This was the case with both supports and reserves. The appearance of the British infantry in attack was usually that of three or four lines of riflemen advancing at intervals behind one another. The intervals were quite sufficiently increased in the later stages of the campaign.

Halts to fire were made at from 1,500 to 1,300 yards and the advance was made, as a rule, by rushes when under the enemy's fire. Before the assault, that is to say at distances varying from 400 to 200 yards, sometimes even less than 100 yards, and even 50, the defending force was overwhelmed with magazine fire for a time, until his defeat was assumed to have been accomplished. Supports from behind sought to carry forward the front lines encouraging them by joining in their fire. Moreover, endeavours were nearly always made before the assault to bring every available rifle into the firing line. The artillery accompanied the attack up to short ranges. The whole method of attack had so far much similarity in principle with that adopted by us.

The fire effect against their attack formations was, as a rule, as follows: Against firing line, where men advanced with an interval of about two paces between each, rifle fire was generally not of an overwhelming character at ranges between 1,000 to 800 yards, and the British might generally be seen advancing at those distances without much difficulty. It must, however, be admitted that, as a rule, they had

no shrapnel fire to contend with. Whenever this was the case, I have seen the British firing lines, when in the open, throwing themselves on the ground at ranges of 1,500 to 1,000 yards, and calling "Halt," after they had advanced only a few hundred yards under fire. In ordinary line or column formation matters were quite different, as at a range of 1,800 yards the effect of rifle fire was serious. The Boers were admittedly deficient in the art of volley firing. As if to make up for this, however, the clear air and the dry dust made it everywhere possible to observe the impact of every individual shot up to 2,000 yards.

After what I saw in South Africa I am inclined to the opinion that infantry fire at ranges over 1,000 yards only promises good results when it is directed at troops in column and at firing lines pushed forward one on top of the other and in upright positions, at artillery when more or less isolated or in movement, and at troops of cavalry at uniform distances apart. In such cases the fire is frequently annihilating. But, perhaps, the more dense atmosphere of our own country, the inferior eyesight of our own people, and difficulty in observing infantry fire, would limit its effect more closely.

As soon as the British firing lines reached the zone where fire becomes effective, the losses incurred by troops in movement and not under cover became felt, and soon increased considerably. The fire of a defending line weakly held, according to our ideas, usually compelled unprotected firing lines to throw themselves down very soon. Frequently the latter dispersed in a short time into isolated groups, and crowded behind whatever cover they could find.

The supports in rear usually suffered such losses when advancing to the firing line that they were unable to reach it. Progress in the attack was only therefore, as a rule, possible when the nature of the terrain was such as to lessen the effect of the defenders' fire. The British soldiers lacked the versatility and independence of action which might have made them creep forward of their own initiative, when in the small groups into which circumstances had thrown them, as soon as advancing in the ordinary way and standing up was no longer possible. The influence of the leaders did not extend beyond the next group to that of which they themselves formed a part. This was frequently noticeable in the fruitless endeavours of individual brave officers, who got up or tried to rush from one group to another, almost always paying for their bravery with their lives. This was the way that the British firing lines behaved at the fight on the Biddulph's Berg, scattering themselves in a few minutes into such isolated groups. The men lay down flat on the ground, and after a few vain endeavours on the part of their officers were no longer to be got forward. The former were generally shot before they made any progress.

Supports and reserves, as far as I could see, rarely succeeded in reaching the firing line; they likewise lay down on the ground. Wherever the country was open the attack came to a standstill at about 800 to 600 yards from the defenders, and after an advance under fire of scarcely more than 150 to 200 yards. The losses at these distances were pretty severe. I have seen this and the following happen in more than twenty fights in just the same way.

On the other hand, against troops lying down, especially when they were able to get some cover, the effect of the Boers' fire at these ranges was small: even at 500 to 400 yards this fire was surprisingly ineffective. The Boers, however, knew this very well, and the better commandoes rarely opened fire on prone objects at ranges over 400 yards.

The British fire, also, in the earlier stages of the attack was never very effective, nor was it ever over-dangerous at any time. The Boer fire was, on the contrary, in the main good, if not quite as brilliant as our newspapers describe it. After what I have seen, and in so far as a comparison is possible, I would say that our infantry is at least equal to the average of the Boers in marksmanship. The eyesight only of the latter is better.

The advance by rushes of the British was done in much the same way as we do it. Long lines stopped firing, got up almost simultaneously and rushed forward 60 or 100 yards, and then threw themselves down again. At ranges under 800 yards and in the open these rushes soon had to be stopped. And even when it was possible to maintain them, they were generally extremely costly.

Several mistakes were, however, apparent in their carrying out, viz.:—

1. The cessation of fire (prior to movement) was too sudden;
2. The rushes were too long; and
3. The advances should have been made in much smaller groups.

An advance or rush under effective fire ought not to be long enough to admit of the enemy taking aim, and this would not be more than thirty paces at a range of 800 to 600 yards, at closer distances even less; and within 400 yards, or indeed within the range of the fixed sight, rising upright will no longer be possible for groups.

As regards long lines, they are dangerous for the following reasons:— A line of 50 men even is too large to be put in movement all at once. The men do not all rise together; this gives a watchful enemy time enough to greet those who get up last with a well-directed fire. Accordingly, even short rushes with long lines become too costly to be carried out for any length of time. Small groups, on the other hand, can be put in movement in a marvellously short space of time, and

surprise, in my opinion, is the only thing that can guarantee a rush success. For this reason it should only last as long as the surprise. Everything likely to attract the attention of the enemy by a sudden cessation of fire must, therefore, be carefully avoided. And this is alone possible in the case of small groups.

A great mistake in the British method of attack was the endeavour to carry it out too quickly, and the almost complete absence of mutual support in the case of infantry fire. True, the artillery accompanied the advance to within a range of 400 to 300 yards. But then it became silent, and the infantry alone continued to fire at the stones, behind which it could see nothing. Then a pause ensued. The shouts of the officers to cease fire, and the fixing of bayonets, enabled the defenders to prepare their fire without haste. It is probable that the shrill tone of our whistles would attract the attention of the enemy in like manner. Following this, the long lines of the attackers sprang up, and the last act of the drama began. Absolutely unperturbed, the Boers directed their fire on the huge targets offered by the advancing swarms of men, at short range. Onsets such as these were almost always shattered, whether the distance at which they were commenced was 300 yards or 50, and a few seconds were frequently enough to decide the matter.

Is it, then, to be wondered at if the Boers placed unbounded reliance in their rifles, especially at short ranges? Is it to be wondered at that many of them allowed the enemy to almost close with them, in order that the extermination of the latter might be the more thorough?

On more than one occasion it has happened that they deliberately evacuated the crest of a kopje and retired to within as little as 50 yards behind it. On the arrival of the British at the crest, according to their custom, they celebrated the occasion by indulging in loud cheers and cries of "Majuba," when they were promptly wiped out on every occasion, by a comparatively small number of rifles at practically point-blank range. This may sound strange, considering the few occasions on which I have admitted the energy of the Boers.

Their contradictory nature is, however, only too apparent. The Boers recognise on the moment with unfailing certainty what is dangerous and what is not dangerous in the occupation of a position. A foe which is advancing without firing is not dangerous, notwithstanding his superiority in numbers. For in this case one can fire more, and the nearer he approaches the more surely and effectually is the defeat of the attacker brought about. No one will ever succeed in bringing troops forward again who has learnt what it is to advance over open ground under heavy fire without protection of any kind.

But to combat the reply that only demigods like the Boers can bring about such results, I should like to adduce two examples in which *Germans*

were the chief actors. These men were, as a rule, artisans with imperfect training in shooting or none at all, and who had only learned or relearned what they could in the course of the campaign. They should, therefore, not be compared with our own infantry. Moreover, in many cases it was the foreigners, and that, too, the Germans, who had the largest share in deeds of heroism. "The latter were the most numerous in all the commandoes." But these allies were never made mention of by the Boers.

On the night between the first and second day of the engagement at Thabanchu, the right wing of the Boer forces evacuated the battle-field without any reason whatever, whereupon the English surrounded the Boer position on the Thaba mountain, which was practically the centre of the exposed flank. Cavalry pressed us in rear, whilst artillery took us in the right flank. To withstand the threatened outflanking movement of the British infantry we (that is to say a German corps) had to take up positions on several small kopjes, and on the kopje on which I found myself we numbered about thirty rifles. Individual marksmen lay behind single rocks at intervals varying from three to five paces or even more, being scarcely able to raise their heads owing to the British shrapnel. Covered by the fire of the latter the British infantry had approached to within 200 yards of our position and kept up a continuous fire from behind a thorn bush over our heads.

This lasted hours, and cost us only a few killed and wounded. The British artillery had then to give up its position and cease fire. Several times had the shorter lines of our opponents attempted to advance, but were compelled after a few moments to throw themselves down. Finally, the whole British firing line, amounting in my estimation to between at least 300 and 400 men, advanced to the assault. The orders of the officers to cease fire, followed by "Fix bayonets," were plainly audible, and the cry "God Save the Queen" ran down the ranks. Then everyone got up. As they rushed towards us they seemed to me like a thick yellowish-grey mass, advancing in close order, and often three or four men deep, as is also the case when carrying out assaults in our Army during peace-time. Fire was opened simultaneously along our front. At first somewhat wild, and then, as the men became calm under the encouragement of the most experienced warriors, who shouted such words as "Steady, boys, and not a man will get near you," fire was directed to the proper quarter. Thicker and thicker did our opponents advance, but when they were within eighty paces they collapsed. Parties threw themselves down between the crags and fired, but the majority rushed back to cover to the shelter of the bushes, and were scarcely to be stopped even there. The battalion, for such it must have been, was annihilated as a fighting

body, and the losses were, as far as we could make out, very large. Unfortunately, however, those who remained behind prevented a compilation of the numbers of the fallen.

The second case of this nature, of which I was an eye-witness, happened at the Klip River, near Johannesburg. I was there endeavouring, with about twenty-five men, to cover the withdrawal of some pieces of artillery which were under a heavy fire. Their teams had been so decimated that the crossing of the river caused a considerable loss of time, and the British infantry in several lines had managed to get pretty close. It was with difficulty that I succeeded in bringing my handful of men to a halt on the reverse slope of a plateau-shaped kopje. We lay down behind a row of rocks, and had in front of us a clear field of fire some 300 yards in length, bounded by the crest which the British had to cross. Further than this we could not see.

The foremost line of the advancing khâkis threw themselves down behind the crest when surprised by our opening volley and maintained a fire which was as wild as it was ineffective, for a slight intervening rise in the ground prevented both parties from seeing one another when lying down, and the British seemed greatly afraid of standing up to fire. Every time that fresh supports came up, they tried another advance, and every time their offensive powers collapsed when they got within about 80 yards of our lines. After the third attempt they seemed to have had enough of it, when they evacuated almost all the ground they had already gained. I cannot say what their strength was taken all round. A comrade of mine, an ex-German officer, told me later that he had counted 120 killed on the following morning. Personally, I was called away before sunset, and was therefore unable to verify his estimate. For this reason I cannot say for certain if this gigantic number is the correct one.

The British artillery generally ceased firing too soon after the commencement of the infantry attack. On the other hand, when we attacked, the Boer guns maintained their fire with vigour and for hours over our heads, till we got within 150 yards of the enemy. Shrapnel sometimes burst almost immediately above us, without hitting anyone. In fact, I believe we should have rather received a few wounds than have done without this support.

Of Boer methods in defence, note the following:—Firing lines in combination were formed only in proportion to the extent of cover available. As a result of this, the formation assumed that of a line of independent groups varying in strength. The men often lay side by side when under cover, but the various groups were often separated by hundreds of yards of open ground.

The security of the flanks was always the first consideration. For this reason the front became extended at the expense of weakening the garrison. As already stated, the Boers usually only fired at standing-up objects, others were generally left unmolested at ranges of over 300 to 500 yards. Fire was directed on the supports and reserves whenever the latter offered better targets than the firing line. Supports were frequently to be seen throwing themselves on the ground or turning back, whilst the firing line was still endeavouring to advance. If the objects to fire at did not make good targets, they did not even expose themselves to the enemy's view or fire, believing that the time when they would become so would be sufficient to bring about their destruction.

I consider the Boer methods of defence in all respects practical, except the absence of supports echeloned in rear of the flanks. The range of our rifles is so great that gaps in a firing line are just as well defended as those portions which are occupied, as long as the ground in front can be effectively swept; this means in open country that several hundreds of yards can be so defended. The occupation of ground in this manner is generally preferable, as one can thereby collect one's forces behind separate positions under cover from whence it is easier to reserve one's fire. I believe, too, that this principle is an important one for artillery also.

After what has been said, the Boer methods of attack can be treated at shorter length. Artillery superiority was never aimed at nor waited for. When possible, darkness was chosen for advancing to within effective range of the enemy—that is to say, to within 200 to 300 yards.

In day attacks, however, only those points were chosen where the nature of the terrain admitted of an advance under cover. No one ever thought of crossing open ground of wide extent. Accordingly, it often happened that the enemy was attacked by isolated groups or groups far apart from one another. Reserves were not made use of.

During the advance the various groups pressed forward together within their own sphere or separated so as to avoid ground swept by fire, and to make use of whatever cover was available. In the accomplishment of this they did not mind making extensive circular movements, whereby it often happened that a single hill gave shelter to several lines each behind the other. They much preferred being pressed for room behind natural features offering cover to making use of open ground. As long as they were not seen, they marched in single file through narrow portions of ground. Of course it was seldom possible to absolutely avoid open spaces; on such occasions they generally moved forward by creeping along the ground, or, in exceptional cases, by making very short rushes of from 10 to 20 paces, and in groups of two or

three men, or singly. It was remarkable that the British were generally too late with their fire in the case of these rushes.

When coming under shrapnel fire another principle was often adopted. The group against which a shrapnel was directed got up and made use of the following moments of quiet to rush forward at full speed to the place over which the shell would actually burst and then throw themselves down before the next came. This method seemed to me a very practical one, especially in places where one was screened from view.

As long as they could hope to approach the enemy unobserved, there was no firing; in other cases a mutually supporting fire at a range of from 1,000 to 800 yards was opened, and this was carried out uninterruptedly by small groups, of which the one fired and the other advanced a few paces alternately. The less cover there was and the nearer they approached the enemy, the smaller became the groups and the shorter the advance. The carrying out of the advance entirely rested with the individual Boers; commandants and field cornets merely started the commandoes.

The grey-brown garments of the Boers, which were difficult to see, and their flat headdress, were of great value on these occasions. The former were more difficult to see than the khâki clothing of the British. The latter also were better than the high tropical helmets, which made their wearers visible at a long distance, and in consequence of which the British lost many men in their engagements.

Good fire effects against an enemy lying down as a rule only began within 400 or 300 yards; at this distance a sort of target-practice was commenced at every khâki helmet, combined with most careful protection of the individual person, and a gradual pushing forward in the prone position. Nobody got up, so as to be better able to see, as the British so frequently did, to their cost. The Boers rather kept creeping forward till something became again visible, or remained lying down if the foreground offered too little cover. Naturally, in this way, the various groups advanced towards the enemy at unequal distances. For although the principle was the nearer the better, this only was carried out when the same was possible, and, as a rule, the necessary energy was wanting to give it effect.

Accordingly the attack in its last phase assumed the character of a standing musketry duel. At least, this was generally the case where open country separated opponents. In other places the Boers approached to within 100 to 50 yards of the enemy. They were just as much superior to the British in the art of shooting as in that of taking cover, and the latter generally treated both as a secondary consideration in an engagement.

Decisive results, owing to the great superiority in numbers of the British, usually only took place when the Boers attacked from several sides and the country favoured close approach. But sometimes their success was astonishing in its extent. By getting closer and closer with their fire and creeping forward, the superiority of the attackers' fire became more and more complete. The firing line of the defenders did not dare to raise their heads anywhere, and the detachments in rear were defenceless when exposed to the concentric fire.

Spion Kop, Nicholson's Nek, Estcourt, Nitral's Nek, and other places bear brilliant testimony to such successes of the Boers. British prisoners declared that their people, when opposed to this constantly approaching fire which admitted of no resistance, completely lost heart, and were sometimes actually longing for a rush and assault on our part.

The reason for these successes is, in my opinion, due to the circumstance that the Boers before all else, paid particular attention to cover and mutual fire support in their advance, and endeavoured in the last stages of the attack to make the fullest possible use of their rifles. By this means they robbed the defender of his advantage, namely, that of being able to shoot undisturbed at defenceless men, approached him under nearly equal conditions and obtained superiority by more intelligent action on the part of individuals, and by bringing a simultaneous fire to bear from several points on to one. From this we can see that even superior tactical formations united with superior numbers, as was the case with the British, are of little use in the case of modern fire-arms if these points are not observed.

On the other hand, troops, in spite of a deficiency in every sort of tactical training and discipline, often attained brilliant success against manifold superiority in numbers. They almost always succeeded in working their way towards the enemy without suffering serious loss. The latter, is I think, the vital point in our infantry tactics of to-day. Time wasted at it is at any rate considerable. I mean that the experiences gained in these engagements is of the greatest importance to the infantry, for the reason that they have shown that it is possible for infantry to carry off the victory under certain circumstances without the aid of artillery.

(*To be continued.*)

THE ARMY AND THE NATION.

By General E. F. CHAPMAN, C.B., R.A., p.s.c.

THE present system, by which the Army has been territorialised, was initiated in 1872. The United Kingdom was then divided into military districts, the districts were again sub-divided into infantry brigade or sub-districts, and were placed under a colonel who represented the interests of the regiments that were thenceforward to be associated with the area placed under his command for recruiting purposes, and for the training of the Militia and Volunteers maintained within that area.

This organisation has borne the test of thirty years, and the connection maintained by corps with counties has commended itself to the Government and to the people.

Yet the complete incorporation of the Army with the nation, which was intended as the outcome of the short-service system, and which this arrangement foreshadowed, has never been carried out. Under the long-service system, in which the soldier engaged for twenty-one years with the prospect of pension, a class Army had been produced which was isolated from the life of the nation, and such the Army partially remains, although the nation has now fully realised that the Army is identified with its daily life, and that in time of war the nation, through its Volunteers, may share intimately in the trials and hardships, in the difficulties and success, of the Army. Patriotism and sorrow have bound the Army and the nation intimately together in a way which no organisation of man's device could have done.

The fact is that, from a variety of causes, the civil departments of the State were not, from the outset, called upon to share in adapting the military territorial organisation to the county organisation of the country, which dates from the earliest development of the nation; yet the subtle influence of those departments on the well-being of the Army in all its stages should not be under-estimated.

The education of our boys, the local responsibility regarding them until they are qualified to bear arms, and their settlement as men in civil life, after service with the colours, are surely very potent factors in enabling a national Army to be maintained in a state of efficiency and at proper strength; while any attempt at economy can only be rendered

effective by a union of all departments concerned with such matters and in the adoption of measures which would tend to make the territorial system a reality.

The South African War has brought into prominence the necessity for Great Britain to possess a first-rate Army, ready to go anywhere and to confront the enemies of the Empire in any part of the globe. The realisation of such necessity has been wonderfully gradual, owing to the happy position of Great Britain in regard to Continental nations, and to the fact that our Indian and Colonial wars hitherto have seemed to be well within the powers of the Indian or Colonial Governments to deal with without making special appeal to the nation. Indeed, it is doubtful whether the necessity for such an Army has yet been fully realised, and no one has so far ventured to grapple with the problem as to how the British Army of the future is to be provided by voluntary enlistment, nor have steps been taken to change or develop the existing recruiting system.

The number of recruits of eighteen years of age and upwards till now required annually has been from 30,000 to 40,000, and this number will certainly be greatly exceeded in the future. Yet such is the wastage that in each year only some 17,000 men are passed to the Reserve.

The recruiting system is a good example of old-world methods for a new world's necessities; the recruiting sergeant still hangs about outside the barracks where recruiting takes place and saunters up to any young man who appears to be sufficiently idle to enter into conversation with him and sufficiently poor to be tempted by the King's shilling. By this method the restless youth who is unable or unwilling to obtain fixed employment in civil life is drawn into the ranks of the Army, and the tradition is maintained amongst parents of the working class that their sons have been caught for a service which compares unfavourably with the labour to which they are accustomed. Surely this belongs to a time when the Army was very different from what it is now, and when nobody expected the Army to be recruited except from the lowest classes of the people.

It has been for many years alleged, as an obstacle to any reform of the Army, that if you insist upon character too strongly, or if you make service in the ranks as industrious a career as that of an artisan, you will no longer tempt the idlers of the nation to join the Army, and will thus interfere with recruiting. This argument may still be used, but it ought no longer to be tolerated. Since the adoption of short service, the whole trend of things in the Army has been to induce the industrious part of the population to enter the ranks and enable them to pass again into civil employment without any loss of capacity for such work, and it

should be added that during the years of service with the colours the soldier is provided with unusual opportunities of self-improvement, and leads a physically healthy life. No doubt there is self-restraint involved in any engagement for seven years, and the life of a soldier is essentially one of discipline; but comparing it with the life of almost any unskilled labourer, and with that of many artisans, it is surely a career which wise parents may welcome for their sons rather than regard as a refuge for the least competent of them and even as a disgrace to the family.

Recruiting for the Army is carried on by a staff (under the orders of the Inspector-General of Recruiting) of non-commissioned officers and pensioners, who are employed under recruiting staff officers in our cities and towns, and by a similar staff of non-commissioned officers whose duties are carried on under the direction of the colonel commanding the regimental or sub-district. Enlistment is regulated by the Annual Mutiny Act and by the Enlistment Act of 1870, the former legalises the maintenance of an Army and lays down the number of men and the manner of enlisting them, the latter fixes the period and conditions of service. The means employed are undignified, the methods out of date, and the recruiting offices unsuitable for the work.

The War Office has hitherto been struggling, unaided, to attract youths to the colours in the face of opposition from parents and friends and in competition with every branch of civilian labour. The limit of numbers attainable under the present system has been reached. If, then, we are to arrive, with due regard to economy, at a more effective system for obtaining men who are better qualified for military service than are the present recruits, and if we are to avoid the large wastage in men that now occurs, some very important and necessary changes in our recruiting system can no longer be delayed.

The conscript Armies of Europe may indicate the alteration that it is desirable to introduce—a civilian element must be incorporated with the too purely military machinery which now attempts the work of raising men for the King's service.

Taking the German as an example of what is carried out by Continental nations, we find that every town and village has its appointed place in the general organisation, and that this fact is indicated on notice boards placed conspicuously in them. At the beginning of each year lists are prepared from the parish registers of all young men who have attained the age for military service. In the spring, about May, the Battalion Recruiting Commission commences its labours.

This commission is composed of the Landwehr battalion commander, the Landrath or chief civil functionary, two officers, and a surgeon, as permanent members, and four local members, taken from

the most respectable inhabitants of the different villages. The existence of a Recruiting Commission so constituted ensures the fullest consideration for every individual that presents himself.

We might well adopt a method somewhat similar. If parish councils, or some other local agency, were to assist in obtaining recruits, and if the inspection of candidates were made at fixed periods by a duly constituted committee, in which the local civil authority had his place, we should secure :—

1. The obtaining of suitable recruits in sufficient number.
2. Their joining at fixed periods, resulting in economy in training.

And although there need be no interference with the liberty of a recruit to select the corps in which he may elect to serve, the local agency which assisted his enlistment might take care that, if he desires it, he should be able to find employment when he passes to the Reserve, in the locality where he has registered his name, the history and character of each individual during the seven years of his service with the colours being made a matter of local concern, as well as his re-settlement in civil life.

The principle would thus be established that a soldier remains a citizen throughout his military service and is recognised as a citizen at its conclusion. If a Royal Commission might determine in what manner the civil departments of the State could best aid the Recruiting Department of the War Office and assist locally the military machinery at work, I feel certain not only that the existing barriers which now divide the Army from the nation would gradually disappear, but that the maintenance of our Army by voluntary enlistment would also be secured.

NAVAL NOTES.

HOME.—The following are the principal appointments which have been made: Captains—J. Ferris to "Indus," for Dockyard Reserve at Devonport: D. A. Gamble to "Hyacinth": C. E. Madden, to "Renown," for charge of Torpedo Flotilla: A. H. Anson to "Hawke"; C. G. Dicken, to "Audacious," for charge of Home Torpedo Flotilla. Commander—G. B. Hutton to "Hero."

The new first-class battle-ship "Irresistible" commissioned at Chatham on the 4th ult. to relieve H.M.S. "Devastation," as port-guardship at Gibraltar. H.M.S. "Goldfinch" commissioned at Sheerness on the 4th ult., and left on the 20th ult. for the Mediterranean, for surveying duties. The new sloop "Espiègle" left for China on the 4th ult., where she relieves the first-class gun-boat "Pigmy." The second-class cruiser "Iphigenia" arrived at Portsmouth from China, on the 11th inst., with relieved crews, and will pay off at that port. The first-class cruiser "Diadem" paid off at Chatham on the 11th ult.: her place in the Channel Squadron will be taken by the first-class armoured cruiser "Sutlej," which is to be commissioned in May. The third-class cruiser "Philomel" arrived at Devonport on the 19th ult. from the Cape, and will pay off at that port. The first-class cruiser "Amphitrite" arrived at Plymouth on the 21st ult. from Hong-Kong, with relieved crews; she has since proceeded to Chatham, and is being prepared for service on the China station. The third-class cruiser "Brisk" from China is to pay off at Malta, where she will be placed in the Reserve. The third-class cruiser "Magicienne" is to be commissioned as a sea-going tender to the "Britannia."

The Controller's Department and the late Director of Naval Construction.—In his explanatory statement on the Naval Estimates the First Lord calls attention to considerable changes which are being made in connection with the Controller's Department, with the view in the first place of relieving the Controller, as far as possible, of all work not directly connected with the construction, reconstruction, and repair of ships, or the management of dockyards; and similarly to relieve the Director of Naval Construction of all work not directly connected with the designing of ships and the superintendence of their construction in accordance with the designs. The First Lord takes the opportunity of expressing "the great regret of the Board that Sir William White, K.C.B., has been obliged, through ill-health, to resign the post of Director of Naval Construction, which he has filled for sixteen years with conspicuous ability and success, and in the memorable work of which he has been constantly supported by the efficiency and zeal of the officers of the Royal Corps of Constructors, of which he has been the chief. Mr. Philip Watts, of the Elswick Works, formerly an officer of the Royal Corps of Naval Constructors, has been appointed to succeed him."

This feeling of unfeigned regret at the retirement of Sir William White from the service of the Admiralty and of the country, to which the First Lord on behalf of his colleagues and himself gives graceful expression, is one which is fully shared by all who have the slightest acquaintance with the great work accomplished by Sir William during his long tenure of office, the more so as the cause of his retirement is the lamentable failure of health, brought on, without a shade of doubt, by exhaustive and unrelaxed devotion to his difficult duties.

No one who is on the outside of the official circle, and perhaps of the inner portion of that body, can fairly estimate the work imposed on the Director of Naval Construction in reconciling the conflicting views that influence the design of any one of His Majesty's ships. The executive department justly emphasise the particular

arguments that refer specially to their branch; so do that body, growing daily in importance, the engineers, and the Constructor has to amalgamate the compiled ideas of all. Hence the conflicting demands of speed, defensive and offensive armament, fuel supply, seaworthiness, habitability, and steadiness of gun platform, vastly complicate a question that must in all cases end in compromise. Sir William White returned to the Admiralty as head of the technical Constructive Department at a critical time for the Navy. Foreign Powers all over the world were rapidly developing sea power, as represented by fighting-ships, improved in numbers and in design. At no stage of Sir William White's responsibility did he allow the Navy of Great Britain to be in arrears with the designs of our possible antagonists. It is futile to compare designs made fifteen years ago with those of the present day, but ships that we now think somewhat belated, such as the "Royal Sovereign" class, were vastly superior to the class they were calculated to overcome if necessity arose; the scale has no gaps, the Admiralty designs were always somewhat ahead of the contemporaneous ones of other Governments, many of whose vessels, even if suited, as they presumably are, for the purposes of the countries which acquired them, were absolutely unsuited for the demands of this country. The unfortunate commercial strife three years ago hindered the development we ought to have attained, and the difficulties which all nations, equally with ourselves, have in solving with unimpeached success the question of a suitable boiler for a ship whose duty at need is to become a shell target, has checked in some cases the records that might otherwise have been obtained. The last of Sir William White's vessels to be completed at this date has made a stride far in advance of anything yet accomplished by any war-ship of any nation. The "Good Hope," with heavy cruiser armament, good defensive power, and satisfactory coal supply, has accomplished more than 22 knots for 30 hours and 23 knots for 8 hours. It is possible that "cavitation" may have lessened the last result.

Manœuvring Powers of "Implacable" and her Sisters.—The tactical diameter of the battle-ships of the "Implacable" class is very satisfactory, if their great length as battle-ships is considered. A fair summary of their manœuvring power is as follows:—With both engines going ahead at 10-knot speed, and the helm put over to 34°, the diameter of their circle is about 550 yards: at full speed with the same angle of helm, 510 yards: with one propeller going ahead for 10-knot speed, and the other an equal pace astern, and the same 34° helm angle, the circle diameter is 340 yards; with one engine full speed ahead and the other 5 knots astern, and the same helm angle, the circle diameter is also 340 yards. When going full speed ahead, if the engines are reversed, the ship can be stopped in 600 yards.

Steam Trials.—The new first-class battle-ship "London" has at last completed her trials. On her first 30 hours' run at one-fifth her power, the results were as follows:—Steam pressure in boilers, 248 lbs.; vacuum, starboard 27·6 inches, port 27·3 inches; revolutions, starboard 65·68, port 65·26; I.H.P., 3,237; speed, 11·5 knots; coal consumption, 1·81 lbs. per I.H.P. per hour; draught of water, forward 26 feet 3 inches, aft 27 feet. At her 30 hours' run at four-fifths power, the trial had to be curtailed owing to foggy weather coming on. As the results of these trials are calculated on the mean of the best consecutive 24 hours rather than upon the complete run of 30 hours, sufficiently good averages were obtained to allow the trial to be accepted as successful. The ship drew 26 feet 3 inches forward and 27 feet 3 inches aft, and had 262 lbs. of steam in her boilers. The vacuum, starboard, and port was 26 inches, and the revolutions were 101·4 starboard and 100·7 port, produced by a mean I.H.P. of 11,718. There was no air-pressure, and the speed by patent log was 16·4 knots on a coal consumption of 1·8 lbs. per unit of power per hour.

The results of the 8 hours' full-power trial were also successful. She weighed from Spithead about 6 a.m., but it was 9.30 a.m. before the trial actually commenced. The weather was clear and mild, the wind moderate, and the sea smooth. The limits of the area over which the ship moved were the eastern end of the Isle of Wight and Portland. During the first hour the steam pressure in the boilers was 280 lbs. to the square inch, and the air pressure in the stokeholds was 0·1 inch, with an even vacuum of 25 inches port and starboard. The revolutions were 108·6 starboard and 108 port, and the collective I.H.P. 15,442, with a coal consumption of 2 lbs. per unit of power per hour. In the second hour the revolutions averaged 109 and the H.P. 15,755, while the coal consumption dropped to 1·75 lbs., and the air pressure in the stokeholds was raised one point, where it remained. At the third hour the steam in the boilers was reduced to 275 lbs. and the I.H.P. was 15,210, the coal consumption being 1·88 lbs. During this hour the loss of water was 2½ tons, which fell to 2 tons in the next hour, and then there was no further trouble from this quarter. The steam in the boilers had been reduced to 270 lbs. and the revolutions to 107, while the I.H.P. came down to 15,076, but the coal consumption went up to 1·96. In the fifth hour all the figures were advanced, the steam in the boilers being 275 lbs., the vacuum 25½ inches, the revolutions 108, the I.H.P. 15,356, and the coal consumption 2·11 lbs. In some respects the same conditions were observed in the sixth hour, but the revolutions came down to 106·4 and the I.H.P. made a small drop to 15,347, and the coal consumption fell to 1·84 lbs. At the seventh hour the steam in boilers dropped to 270 lbs., but the revolutions went up to 107·1 with 15,130-I.H.P., and a coal consumption of 2·1 lbs. In the last hour, with a steam pressure of 275 lbs. and 109·1 revolutions, the I.H.P. was 15,160, and the coal consumption 2·1 lbs. The mean I.H.P. for the eight hours was 15,264, and the mean coal consumption 1·97 lbs. per unit of power per hour, the mean speed by patent log being a fraction over 18 knots.

Coaling at Sea.—The first stage of the experiments in the coaling of ships at sea has been concluded at Portsmouth, writes a correspondent of the *Times*, and Captain A. R. Wonham, R.N., who has had charge of the trials, reported the results recently at the Admiralty. The absence of any facilities for coaling at sea was demonstrated during the blockade of Santiago, when ships had frequently to absent themselves to coal, and during this crisis Mr. Spencer Miller, a New York inventor, was requested by the United States Navy Board to devise some means of coaling during the blockade. By his methods it was found possible to put on board 22 tons an hour and he co-operated with Mr. Temperley, whose transporters are in general use in the British Navy for coaling purposes, with the result that with improved appliances the problem appears to be near solution. The collier "Muriel," which was sent to Portsmouth seven months ago, was fitted with a large square mast, from the top of which a cable-way extends to the quarter-deck of the ship to be coaled. For the purposes of the experiments the "Trafalgar," port-guardship at Portsmouth, was supplied with the necessary gear, and after several preliminary trials of an initial character, the "Trafalgar" put to sea towing the "Muriel," whose engines were so slowed down that they did not give the ship steerage way. The "Trafalgar" then steamed head to wind at a speed varying from 8 to 10 knots, but from time to time one ship or the other sheered off a straight course and so reduced speed of coaling. The "Trafalgar," having with two hawsers taken the "Muriel" in tow, the main cable was hauled on board the "Trafalgar," and made fast to her mainmast about 10 feet below the fighting top. The tail block, through which the travelling line passed, was sent to the "Trafalgar" along the main cable and made fast about 4 feet below the main cable on the "Trafalgar's" quarter-deck about 100 feet abaft the mainmast. A guide-post was erected, through which both these ropes passed and were

so adjusted that, controlled by fairleads, they could slide up and down a distance of about 30 feet. Parenthetically it may be mentioned that any war-ship supplied with the guide-post as tried in the "Trafalgar" can get into communication with a collier at sea, and there is no need for boats or other laborious methods of conveying cables from ship to ship. As soon as the ropes had been made fast, coaling began and six bags of coal, each containing 2 cwts., were sent from the deck of the collier to the masthead by means of a lift working on rails on the side of the mast, and were then transferred to a traveller. The traveller containing the six bags of coal was then drawn across to the battle-ship by a steel wire rope, which was coiled in by an engine. On reaching and striking the tail block in the "Trafalgar" the load was released and fell on the deck of the battle-ship. The empty trawler was then drawn back to the collier by another wire rope, worked by another engine, and at the beginning of the return journey the fair-leads were hoisted to the top of the guide-posts by the upward strain of the main cable and secured in this position. When the traveller approached the guide-post on its next journey the fair-leads were released and the load gradually reached the deck of the battle-ship. The tension of the main cable to keep the bags out of the water was maintained by a spring, which can be adjusted while working, and is so fitted that if the distance between the two ships should be increased the drum pays out, or if the two ships come together the drum coils in a sufficient quantity of rope to keep a uniform tension. The two ships were 350 feet apart, measured from the bow of the "Muriel" to the stern of the "Trafalgar," and a steady head to wind course was pursued to prevent the collier from drifting on to the battle-ship. The operation last two hours 55 minutes, and in this time 89·8 tons of coal, or an average of 30·8 tons an hour were transferred from the collier to the battle-ship. The quickest run was 47 seconds or an average of 46 tons an hour, and it is believed that with further experience this rate of coaling at sea can be maintained.

The initial experiments were all carried out alongside the dockyard and the last trial took place in favourable weather at sea, but it is expected that the next trials will be conducted in bad weather at sea, in order to give the apparatus a complete test before it is finally adopted in the Service. At the trial, which was intended to demonstrate the practicability of the scheme, only six bags of coal were carried at each journey, but there is no reason why eight bags should not be carried, thus adding 25 per cent. to the speed of coaling.

The Navy Estimates. The First Lord's Statement.—The "Statement of the First Lord of the Admiralty explanatory of the Navy Estimates, 1902-1903," is now issued as a Parliamentary paper [Cd. 950]. It is cast this year in a somewhat novel form, the general "Statement," which we print in full below, being followed by a long and detailed "Statement of Work, 1901-2, &c.," reviewing the work accomplished in various departments during the administrative year now drawing to a close :—

The Estimates for 1902-3 amount to £31,255,000, as opposed to £30,875,000 for the current year.

ADMINISTRATION.

The Admiralty has been expanding concurrently with the general expansion of the Navy, and it is one of the most important duties of the Board to supervise this expansion and to see that it takes place on sound lines. The dangers to be guarded against are excessive centralisation, imperfect devolution of responsibility for details on subordinate officers and the consequent over-burthening of the higher officials who ought to reserve their strength for the main direction of administration, the consideration of principles and improvements in the Service. Most important of all, the development of the peace

administration must be on such lines as make for efficient war administration. The Board are keenly alive to the importance of this aspect of the question.

Considerable changes have taken place, or are in contemplation, in connection with the Controller's Department. The general object which the Board have had in view has been, as far as possible, to relieve the Controller of all work not directly connected with the construction, reconstruction, and repair of ships, or the management of dockyards, and similarly to relieve the Director of Naval Construction of all work not directly connected with the designing of ships and the superintendence of their construction in accordance with the designs. The authority of Admirals Superintendent of Dockyards has been increased and their power enlarged, with the object of diminishing the number of references to the Admiralty. To the great regret of the Board Sir William White, K.C.B., has been obliged through ill-health to resign the post of Director of Naval Construction, which he has filled for 16 years with conspicuous ability and success, and in the memorable work of which he has been constantly supported by the efficiency and zeal of the officers of the Royal Corps of Constructors of which he has been the chief. Mr. Philip Watts of the Elswick Works, formerly an officer of the Royal Corps of Naval Constructors, has been appointed to succeed him.

The Naval Ordnance Department has been formed into a separate branch of administration, and is no longer a sub-branch of the Controller's office. Colonel Sir Thales Pease, K.C.B., who has inaugurated and administered the Naval Ordnance Store Department with signal success, is, I regret to say, shortly retiring. The Naval Ordnance Store Department will henceforth become an integral sub-branch of the Naval Ordnance Department, under an officer to be designated "Superintendent of Ordnance Stores."

The Department of the Director of Works has been largely augmented, the position of the officers improved, and the authority of the Director of Works increased.

No large changes have taken place since last year in the other Departments of the Admiralty, which are working smoothly and efficiently.

In the Naval Intelligence Department the permanent number of Naval Attachés has been increased to five.

PERSONNEL.

It does not appear to be fully understood by the Service or the public generally, that by the constitution of the Board of Admiralty the sole responsibility for promotions rests with the First Lord, who, however, in the performance of the difficult and invidious but most necessary task of selection, is accustomed to consult his naval colleagues, and to discuss freely with them the comparative merits of the different officers eligible for promotion. I mention this because the average age of captains on promotion to the rank of rear-admiral has considerably increased of late years, and I consider that the absence from the Flag List of a due proportion of younger officers is a matter of serious moment, and because I recognise that, I am specially responsible for devising a remedy for the future.

Much attention has for some time past been paid by writers on naval matters to the question of the education of the officers of the Navy. I am glad that this is so, because, important as the *matériel* of the Navy is, the *personnel* is much more important. Thoroughly efficient officers and men will always make the best of any *matériel* entrusted to them. No ships, however excellent, will effect anything in the hands of an inefficient *personnel*. The criticism levelled at the present system of training officers in general is that it is not based on one continuous systematic plan, but is the result of a series of independent decisions; in particular it falls under two heads—that the officers are not sufficiently at sea, and that the subjects of the courses at Greenwich are not well chosen or arranged. As regards the general criticism, it is

of course true that the present system of education is, like everything else in the Navy, a gradual growth of time, and not a scheme of one man or of one committee, but I do not admit that it is not coherent. I would say in respect of this as well as of the particular objection to the Greenwich courses that the system judged by its results—the excellence of the officers trained under it—is a good one. Improvements in it there may well be, or a better one may be devised, and the light which criticism sheds on the subject can do nothing but aid the Board in this matter, which is not a simple but a difficult one, and one in which mistakes are more easily made than afterwards rectified. It is far too big a subject to attempt to deal with in the scope of this memorandum.

It has been assumed that the Council of Naval Education are the authority responsible for naval education, but this is not so. The Board themselves are the responsible authority, and the Council of Naval Education simply assist when referred to. The inquiry promised last year has been carried out by the Council, and they have recommended some changes in the system to which the Board have given their approval. One of some importance is in connection with the courses for gunnery and torpedo lieutenants. At the end of the first term the mathematical class is divided after a test examination, so as to enable those showing special aptitude to push forward their studies, whilst the remainder are given more time to devote to careful grounding, and it is also provided that more attention shall be given to voltaic electricity and its practical application in the course in physics. Proficiency in foreign languages certainly requires further encouragement, but at a period lieutenants are constantly employed it is difficult to provide opportunities for study abroad after a young naval officer has once entered the Service. Officers who have qualified have been and are being appointed as interpreters, and receive extra pay as such, while a special instructor in French is being appointed for the tuition of the midshipmen of the ships of the Channel Squadron.

As regards the particular criticism of insufficient sea-training, I think the following figures show that there is no ground for alarm on this score. I cannot admit that midshipmen should be excluded from the comparison. The fact that for the first years of his service the young naval officer is continuously at sea, is, at any rate, one of great importance to his naval education, and if those early years were spent on shore I do not think that a notice of the fact would be omitted from any indictment of the system of his education.

On 31st December, 1901.	Captains.	Commanders.	Lieutenants.	Supplry. Lieutenants.	Sub-Lieutenants.	Midshipmen.	Total.
Service in Sea-going Ships	101	145	718	112	154	679	1,909
Employed on Shore	54	116	192	18	—	—	380
On Passage	3	2	26	2	—	—	33
At College, "Excellent," "Vernon," etc.	12	10	73	—	190	—	285
Other Government Service	—	2	4	—	—	—	6
*Full pay leave, or waiting employment	29	29	23	1	7	15	104
Not wishing employment for private reasons, etc.	5	5	35	1	3	11	60
Total	204	309	1,071	134	354	705	2,777

* Many of these were appointed to ships in the first fortnight of January.

Last year an advance course in naval history, strategy, tactics, and international law was commenced at Greenwich for the senior officers of the Fleet. Excellent work was done in the first session of this course, and I look to the future for its steady and continuous development. If the minds of naval officers are as a result turned to a more constant and thorough study of naval problems, it will have fulfilled the main object the Board had in view in its foundation.

The numbers voted for the current year were 118,625 active service ratings. It is expected that the establishment will have been reached by the end of the financial year, as recruiting has been good. The numbers proposed for next year are 122,500. The increases will consist of the following ranks and ratings :—

Officers	266
Warrant Officers	143
Seamen	1,500
Artisans and electricians	250
Engine-room artificers	150
Stokers	1,000
Miscellaneous	400
Boys (Shipwrights and Coopers)	166
Total	3,875

The recommendation of the Committee on Navy Rations have been adopted, but the new system cannot be introduced simultaneously on all stations till the necessary reserve stocks have been created. It will commence during the year 1903, but the exact date cannot be notified until next year.

The increase of the Reserves has not kept pace with that of the Active Service Ratings, and it has been decided to appoint a Committee, constituted as follows :—

Sir Edward Grey, Bart., M.P., Chairman,
J. Clark-Hall, Esq., Registrar-General of Seamen,
Rear-Admiral R. F. H. Henderson, C.B.,
Sir Alfred Jones, K.C.M.G.,
Commodore The Hon. H. Lambton, R.N., C.V.O., C.B.,
Sir Francis Mowatt, G.C.B.,
Admiral Sir Edward Seymour, G.C.B.,
Secretaries { Lieutenant-Colonel G. G. Aston, R.M.A.,
Fleet Paymaster C. E. Gifford, R.N., C.B.,

to consider how far the Manning of the Navy may be supplied, and the Active Service Ratings supplemented, by Naval Reserves. The terms of reference, which I append, include, among other things, the proposal for the establishment of a Naval Volunteer Reserve.

For the reasons I stated in a speech on the subject last Session, it has been decided not to build ships for the establishment of a new Training Squadron. If the Board had believed that service in masted ships was essential for the proper training of the seamen of the Fleet, a new Squadron of sailing ships would have had to be provided, however difficult and inconvenient. I desire that there should be no ambiguity on this subject, and therefore state plainly that the Board do not consider exercise with masts and yards to be essential for the proper training of the officers or seamen of the Fleet, and that henceforth it is abandoned as a necessary part of their education after they have left the training-ships. The brigs are retained for the boys in connection with the training-ships, and the "Cruiser" is used in the Mediterranean as

an adjunct to the training of the seamen, because practice in masts and yards is excellent both for mind and body. This no one doubts; the question is, is it an essential factor in the sea-training of a modern Naval officer or seamen in order to make him the perfect instrument of warfare which he should be? It is that question which the Board answers in the negative, and the occasions on which, in their opinion, such training is permissible and valuable are those on which it does not displace any part of that training which is essential or conflicts with the exigencies of the Service in the manning and commissioning of fighting-ships. If I am asked what is essential, I would reply all sea knowledge which is necessary for the management of modern vessels of war and their boats under all conditions, and gunnery and torpedo work in all its branches. Further, I believe that the training of the modern seaman should more and more adapt itself to the peculiar characteristics of the ships he has to man. As oars gave place to sails, so sails have yielded to engines and timber to metal. The training of the seamen should, therefore, be directed towards a knowledge of the structure and machinery of a modern man-of-war, and capacity and handiness to deal with and repair it. Gunnery, however, is the most important of all, and in gunnery the emulation between H.M. ships is becoming very keen. But our seamen and marine gunners must be able to shoot straight at long as well as at medium ranges; they must be able to hit their target with the guns trained in any direction in which they will bear; and above all they must never become fairweather gunners. Emulation, therefore, must not be allowed to lead to a restricted selection of conditions and weather for target practice.

The Board have great pleasure in announcing that Her Majesty Queen Alexandra has identified herself with the Navy by consenting to become President of the Naval Nursing Service, and to give it her name. The whole Navy and the Medical Branch in particular will keenly appreciate this gracious act. The recent changes in the conditions of service and pay of the Medical Officers of the Army necessitated an immediate revision of the position of Medical Officers of the Navy. Fresh regulations will shortly be issued giving details of a substantial improvement of pay.

Construction and Reconstruction.

All the money voted for new construction for the year 1901-2 will have been earned and spent by the 31st March. The amount proposed in the Estimates for 1902-3 for new construction is £9,058,000, of which £700,000 will be devoted to the commencement of new vessels. The corresponding amounts for the current year were £9,003,000 and £537,000 respectively.

The Committee on the causes of past arrears in ship-building, the appointment of which was announced last year, has only just completed its labours, and the Board have had no opportunity as yet of considering its report. The report will, with as little delay as possible, be laid before Parliament.

I should like to take this opportunity of making a few observations on the subject of construction. It appears to me that what matters is, not the date at which ships are commenced, but the date at which they are completed and ready for commission. The hull, the engines, the armour, the guns, and the gun-mountings must be timed for delivery, so that the progress of the ship to completion is never delayed. The complete ship, however, is not a net addition to the strength of the Navy unless the *personnel* is sufficiently strong to man her. While the Fleet is increasing, the increase of the *personnel* must proceed *pari passu* with that of the *matériel*, but there is no good and much evil in attempting to increase the *personnel* at a rate which outstrips the supply

of boys and men of the best quality. What is required is to know exactly how many ships of each class are wanted and by what dates, and to arrange for their commencement accordingly. It is not always possible to commence ships at the end of the financial year consistently with their completion at the required time, but I am clear that there is often a substantial administrative convenience in doing so. The consideration of new designs, or the improvement of existing designs, is a long and anxious task; and when a decision has been arrived at it takes months before the sketch designs can be worked out in every detail so that the Dockyards or Contractors can build them. The preparation of the Estimates is such a tax upon the time of the Board during the latter half of the financial year, that the earlier portion of the year is clearly indicated as that in which this all-important question can be most conveniently studied. It follows that the consequent labour of working out the designs in detail brings us towards the end of the financial year: and if ships are laid down then there should be no check or delay in their subsequent construction.

I am also of opinion that, when it is possible consistently with the requirements of the Navy, there is a great administrative advantage in a steady and constant, as opposed to a fluctuating vote for new construction.

Between the 1st April, 1901, and the 31st March, 1902, inclusive, the following ships will have been completed and passed into the Fleet Reserve:—

Battle-ships — "Formidable," "Implacable," "Irresistible," "Bulwark," "Vengeance."

Armoured Cruisers—"Aboukir," "Cressy," "Hogue," "Sutlej."

First-Class Cruiser (Protected)—"Spartiate."

Third-Class Cruiser (Protected)—"Pandora."

Royal Yacht—"Victoria and Albert."

Sloops—"Mutine," "Rinaldo," "Espiègle," "Fantome."

River Steamers—"Teal" and "Moorhen."

22 Destroyers, 4 Torpedo-Boats, 5 Submarines.

On the 1st April, 1902, there will be under construction:—13 Battle-ships, 22 Armoured Cruisers, 2 Second-Class Cruisers, 2 Third-Class Cruisers, 4 Sloops, 2 Auxiliary Vessels, 10 Destroyers, and 5 Torpedo-Boats; and it is expected that between the 1st April, 1902, and 31st March, 1903, inclusive, the following ships will have been completed and passed into the Fleet Reserve:—5 Battle-ships, 7 Armoured Cruisers, 2 Sloops, 2 Auxiliary Vessels, and 2 Destroyers. It is proposed to commence during the financial year, 1902-3, 2 Battle-ships, 2 Armoured Cruisers, 2 Third-Class Cruisers, 4 Scouts, 9 Destroyers, 4 Torpedo-Boats, and 4 Submarines.

The following plan of reconstruction has been decided upon, and great progress will be made with it during the ensuing year. Battle-ships—"Royal Sovereign" class. The 6-inch guns on the upper deck will all be put into casemates, "Barfleur" and "Centurion." All the 4·7 guns will be taken out and replaced by 6-inch guns in casemates. Cruisers—"Powerful" and "Terrible": four 6-inch guns in casemates will be added to the armament of each of these Cruisers, "Arrogant" and "Talbot" classes, comprising 13 ships: All the 4·7 guns will be taken out and replaced with 6-inch guns.

That the repairs to ships in the Dockyard Reserve should be promptly executed, and that the ships themselves should be rapidly passed into the Fleet Reserve, is a matter of great importance. There is no doubt that there has lately been some congestion of this work in the Dockyards, and in order to effect a radical cure it has been decided when convenient to utilise also the private yards where ships were built for the purpose of their repairs.

When destroyers were first designed it was not contemplated that they would be frequently used otherwise than as working from a fixed base. Experience, however, has shown that vessels with greater sea-keeping power are required for service with Fleets, and accordingly the Board have decided both materially to strengthen the type of future destroyers, and also to create a new class altogether, to which the name "Scout" has been given. It is proposed not to initiate a design for this new class at the Admiralty, but to invite the private shipbuilders of the country to give the Navy the benefit of their creative ingenuity by submitting the designs to fulfil certain stated conditions. Moreover, a committee consisting of Vice-Admiral Sir H. Rawson, K.C.B. (president), Mr. John Inglis, LL.D., Professor J. H. Biles, Mr. A. Denny, and Mr. H. E. Deadman, has been appointed to advise the Admiralty in respect of the strengthening of some of the existing vessels. The Board have often been urged to build large numbers of destroyers at the same time: but this advice I do not believe to be sound. In the first place, the destroyer is a type which is still in process of rapid evolution; in the second place, it must by its nature be a short-lived type of vessel: and to build large numbers in the same year would be inevitably result in large numbers becoming obsolete and worn out at the same moment. The true policy seems to me to be steady as opposed to spasmodic construction. Henceforward, Sheerness will be gradually more and more used as the special deckyard at which destroyers will be repaired.

Auxiliary Vessels.

It is often assumed in argument that there is no doubt as to the number of auxiliary vessels that will be required in war, or as to the exact type they should be, or as to the use to which they could be put. As a matter of fact this is not so, except in so far that the Board have fixed exactly the number of auxiliary vessels that according to their present experience would be required in time of war. In all organisations there are two classes of instruments which will be required in time of war—the class which cannot be improvised, and must be fully created in time of peace, and the class which can be improvised speedily on the outbreak of war if proper preparation has been made in time of peace. This is true of auxiliary vessels. Certain auxiliary vessels can, if every preparation has been made beforehand, be taken up from the Mercantile Marine immediately on the outbreak of war. There are others which must be created in time of peace. Although hospital-ships belong to the former class they may be very useful also in time of peace with large fleets, as has been exemplified in the case of the "Maine" (the generous gift of Mr. Baker, a citizen of the United States), which is now serving in the Mediterranean. As regards the latter class, we and all other nations are still in the experimental stage. As I said last year, in the case of Colliers the policy of the Board has been by continual chartering to induce private owners to build as many vessels as possible which are thoroughly suited for the needs of the Fleet. I will take another case as an example, depôt-ships for Destroyers. A different class of ship is required, accordingly as the Destroyers are or are not acting from a fixed base—opinions differ also in the latter case as to the exact use to which these vessels can be put. One class of depôt-ship is being prepared for the flotillas at the Home Ports, and the "Leander" is being prepared as a depôt-ship for the Destroyers in the Mediterranean. From this experience we shall learn more clearly what is exactly required; but if the new Scout class is a success, these depôt-ships should not be wanted for them to the same extent. Again, in the case of distilling-ships, one has been bought and fitted which should be on service within the year, and experiments have been made with others: but obviously it will be far better if by improvements in the boilers ships are able to distill their own water and can be made independent of auxiliary distilling-vessels. This brings me to

a consideration of the question of the type of boiler to be adopted for the future use of His Majesty's Fleet.

The interim report of the Boiler Committee has been laid before Parliament, as also the report of the trials of the "Minerva" and "Hyacinth." The final report has not yet been presented to the Board because the Committee have not yet brought their experiments to a conclusion. Every facility for which the Committee have asked in connection with these experiments has been granted, and every type of boiler of which they recommend the trial is being fitted into ships now under construction.

The country has had to deplore the wrecks of H.M.S. "Viper" and "Cobra" during the past year, accompanied in the latter case by a lamentable loss of life. One result has been for the present to put a stop to our experience with the turbine system of machinery, but the Board are negotiating for a renewal of the experiment in two more Destroyers and in one Third-Class Cruiser.

Meanwhile the question of the use of oil fuel is being very carefully studied and experiments on a thorough scale are being pushed forward under the superintendence of an engineer officer specially detailed for this duty.

Distribution of the Fleet.

The distribution of the commissioned Fleet among the various stations of the globe is a product of time. The present distribution has been gradually evolved in accordance with the peace as well as the war requirements of the Empire. I use the term "peace" in contradistinction to a state of Naval war only, and I may say that these peace requirements have, as the Empire has expanded, become more and more exacting. The origin of the present principle of distribution was in a period when wind, not steam, was the motive power, and when the electric telegraph was unknown. With the changes brought about by steam and the electric telegraph the actual distribution has gradually changed, and adaptability to the needs of the time, and not finality, is the spirit in which the question must be viewed.

At the present moment the position is as follows. It has been possible to withdraw from the China Squadron some of the additions which were sent there under the stress of the emergency of the year 1900, and the last of the cruisers lent to the Cape has returned to the Mediterranean; but, speaking generally, it was only with difficulty that during the past year the North American, Cape, China, and East India Squadrons were able to carry out their arduous duties with the strength allotted to them. The question of the future composition of the Australasian Squadron will be discussed with delegates from the Australian Commonwealth and New Zealand during the course of this year. The Pacific and South American Squadrons are being reduced to three cruisers and one sloop and one cruiser and sloop respectively. At home the Cruiser Squadron is now at its complete strength in numbers, but during the year its strength in quality will be augmented by the substitution of armoured for two of the present protected cruisers.

To this and the experience which will be gained from its work, both by the officers and men, the Board attach great importance; it is fully recognised that the work which our cruisers will have to perform in war requires constant practice and study. The manœuvres in the Channel last year significantly marked this fact, and the idea of the subsequent exercises in the Mediterranean lends itself to a continuance of the lessons then taught. In respect of the battle-ships, the policy of the Board is gradually to change the composition of the Home, Channel, and Mediterranean Squadrons, so that, like the China Squadron, they shall be composed of homogeneous

classes of battle-ships. While the recurrent cruises of the Home, Channel, and Cruiser Squadrons will take place as usual, the manœuvres of this year will not take place in Home waters, but will be carried out by a combination for the occasion of the Mediterranean Fleet with the Channel and Cruiser Squadrons.

I append the usual statement in respect of the work done in the past year by the various departments of the Admiralty.

SELBORNE.

10th February, 1902.

DENMARK.—*Naval Estimates.*—The Estimates for the year 1901-02 amounted to 6,796,495 crowns (£377,583), as against 6,851,449 crowns (£380,580 10s.) for the previous year, being a decrease of 54,954 crowns (£2,997 10s.). Of the whole sum, 5,134,144 crowns (£285,230) is devoted to the maintenance of the actual Fleet, and the balance, 1,662,351 crowns (£92,353), to the subsidiary services. The following are the principal items included in the vote for the Fleet :—

		Crowns.	£ s.
1.	Ministry of Marine	94,134 =	(5,229 13)
2.	Wages of the *personnel*, etc.	795,372	(44,187 6)
3.	Dockyard vote (*matériel* included)	2,877,240	(159,846 13)
4.	Provisions	40,333	(2,240 14)
5.	Medical services	49,000	(2,722 5)
6.	Clothing, etc.	63,534	(3,529 13)
7.	Barrack accommodation	113,041	(6,280 1)
8.	Deepening of harbours, etc.	35,000	(1,944 9)
9.	Instructional establishments...	121,841	(6,768 18)
10.	Armaments	941,900	(52,327 15)
11.	Sundries	97,736	(5,429 15)
12.	Pensions	834	(46 7)
13.	Hydrographical department	36,190	(2,010 11)

A sum of 131,013 crowns (£7,278 10s.) has to be subtracted from above, which brings the sum to 5,134,144 crowns (£285,230), as stated above. Under Heading 3 (Dockyards) is included the vote for new constructions, which is the same as last year, viz., 1,215,000 crowns (£67,500).

Work is to be continued on the new battle-ship "Olfert Fischer," of the "Herluf-Trolle" type, on the repairs of the brig "Ernest," which is be fitted as a school-ship for cadets, on the repair of the surveying-ship "Krieger," on the fixed defence-vessels A, B, and No. 2, and on new boilers for the gun-boat "Guldborgsund."

Among other important items is a sum of 99,000 crowns (£5,500) for ground mines, and 126,000 crowns (£7,000) for the armament of the battle-ship "Herluf-Trolle."—*Mittheilungen aus dem Gebiete des Seewesens.*

FRANCE.—The following are the principal appointments and promotion which have been made : Vice-Admiral—A. P. L. Bienaimé to be Commander-in-Chief of the 3rd Arrondissement Maritime (Lorient). Rear-Admirals—L. A. Caillard to command of Algerian Naval Division ; E. A. Marquer to the Chief of the General Staff of the Navy ; J. M. Puech for service at the Ministry of Marine. Capitaines de Vaisseau—L. R. de Marolles to "Marseillaise" ; V. Y. J. Imhoff to "Amiral-Duperré" ; L. H. Thomas to "Dupuy-de-Lôme" ; V. F. Sauvan to "Valmy." Capitaines de Frégate—A. Guillon promoted to Capitaine de Vaisseau ; L. J. De Monneraye to "Vautour" ; J. P.

M. Rochas to "D'Assas"; P. H. Delaruelle to "Adour" and command of local division in Annam and Tonquin: F. Z. Ian Kerguistel to "St. Barbe" and Défense-Mobile at Dunkerque: M. E. De Kergrohen de Kermadio to "Manche."—*Le Journal Officiel de la République Française.*

Vice-Admiral Bienaimé has taken up his appointment of Maritime Prefect at Lorient, his flag being hoisted on the 15th ult.: his resignation of the important appointment as Chief of the General Staff of the Navy is said to have been due to the recent decree re-organising the Central Administration of the Navy, which considerably curtails the power and responsibility of the Chief of the General Staff. His successor at the Ministry of Marine is Rear-Admiral Marquer. Rear-Admiral Caillard took over the command of the Algerian Naval Division on the 15th ult.

An important commission has been appointed by the Government to consider the organisation of the mobile defences. The members are M. de Lanessan (Minister of Marine), president; Vice-Admiral Fournier, Rear-Admiral Marquer, Rear-Admiral Puech, Capitaine de Vaisseau Perrin, Lieutenant Le Boulicur de Courlon, Commissary Mazerat, Accountant Devinck, Inspector-General of Machinery Barguillet, Director of Naval Construction Lemaire, and Lieutenant Lejay (secretary). In opening the proceedings, M. de Lanessan said that "The mobile defences of France had for some years attained a position of considerable importance, and, on account of the number of torpedo and submarine-boats, are unrivalled by any other maritime Power, and that the time had now come to give to these mobile defences an organisation corresponding to their importance."

The first-class battle-ship "Masséna," which for the past two years has been flag-ship of the Northern Squadron, having made good her defects, left Brest on the afternoon of the 20th ult. for Toulon, where she will take the place of the "Amiral-Baudin" in the Reserve Squadron of the Mediterranean: the last-named ship is to be placed in the 2nd Category of the Reserve. This transference of the "Masséna" is in accordance with the policy of the Minister of Marine to concentrate all the most powerful battle-ships in the Mediterranean; its immediate effect is to leave Vice-Admiral the Marquis de Courthille with only two battle-ships, neither of them first-class, viz., the "Formidable," his flag-ship, and the "Courbet," under his command. It is reported that the old second-class battle-ship "Dévastation," which has been undergoing extensive repairs, will, after her trials, be added to the squadron.

The new first-class armoured cruiser "Montcalm," having completed all her trials, has proceeded to Brest from Toulon, and she is to be ready on the 15th inst. to hoist the flag of Rear-Admiral Gourdon in command of the cruiser division of the Northern Squadron, relieving the "Dupuy-de-Lôme," which ship is to be paid off for a thorough overhaul, including new boilers. The *Yacht* does not consider the "Montcalm" and her sisters satisfactory ships, being not only undergunned for their size, but without adequate protection for the guns they do carry, although an attempt to, in a small way, remedy the undergunning is to be made in the "Gloire" and "Sully" by the addition of two 3·9-inch Q.F. guns and two 3-pounders. The "Montcalm" has been completed in about 18 months from her launching, and this, the *Yacht* thinks, may be taken as a set-off against the long delay in finishing the "Chateaurenault," which is vainly trying to get through her trials, both ships having been built by the La Seyne firm at Toulon.

The following changes in the composition of the fleet in the Chinese waters are reported:—The second-class cruiser "Chasseloup-Laubat" is to return to France and be placed in the Reserve at Cherbourg. The gun-boats "Styx," "Lion," and

"Vipère" are to be attached to the naval command of Cochin-China and stationed at Saigon. When these changes are carried out the squadron will be composed as follows:—

Second-class battle-ship—"Rédoutable" (flag-ship).

First-class cruiser:—"D'Entrecasteaux" (flag-ship of rear-admiral second-in-command).

Second-class cruisers—"Pascal," "Friant," "Bugeaud."

First-class gun-boats—"Décidée," "Surprise."

Despatch and special vessels—"Alouette," "Avalanche," "Argus," "Vigilante," "Olry," and "Takiang."

The second-class cruiser "Descartes" arrived at Toulon on the 10th ult. from China, and is to be placed in the 2nd Category of the Reserve.

The Mediterranean Squadron.—By an order of the Minister of Marine, the effective complements of the battle-ships of the Mediterranean Squadrons are to be reduced by 30 men each, which will result in an economy of 700,000 francs (£28,000) a year. This step has, however, probably been taken to provide more men in view of the considerable number of new ships coming on.

New Ships and Dockyard Notes.—Cherbourg.—The coast-defence battle-ship "Requin" is still waiting orders to commission and proceed to Toulon. There is no doubt this ship has gained a good deal by her reconstruction; her armour belt, formerly below the water, is now sufficiently high above the water-line to afford her efficient protection: she can now steam 15·5 knots easily, instead of the 15 she was originally designed for, while her guns are better protected, and although of smaller calibre than formerly are really more powerful, in consequence of their much better ballistic properties.

The new coast-defence battle-ship "Henri IV." is still continuing the trials of her machinery alongside the yard.

The new torpilleur de haute mer "Rafale" has completed her trials successfully, attaining a speed of 31·4 knots: she is a sister vessel to the "Bourasque," which recently realised a speed of 31·5 knots.

The port of Cherbourg now possesses eight submarine-vessels under the command of Capitaine de frégate Heilmann, which are making almost daily trials and exercises in the offing, and it has become necessary for their general safety and for avoidance of collisions to make certain regulations:—

"During the time submarine-boats are under way, they will carry two vertical metal signal staffs placed at a distance of one-third from the ends of the vessel and flying the national ensign and No. 1 flag respectively. Submarine-vessels showing these signals are to be considered as sailing-vessels for all purposes of rule of the road.

"They will be further always escorted by a torpedo-boat or tug carrying a black and white striped ball at the fore, and at night the lights of a vessel towing; while the submarines will show the lights of vessels in tow.

"The presence of submarines in Cherbourg roads or off the coast will further be notified by the hoisting of No. 1 flag in the forts to the west of the breakwater, and at the semaphore stations along the coast."

Brest.—Fresh trials have been made with the heavy guns of the new first-class battle-ship "Iéna," but the results have not been allowed to leak out; as far as her engines are concerned, the ship has been ready for commissioning now some time, and the delay in doing so has arisen from the serious defects which on her last trial developed themselves in the machinery for working the heavy turret guns.

The Minister of Marine has given orders for the complement of the new first-class battle-ship "Suffren" to be increased, in readiness for the ship beginning her trials. The new first-class armoured cruiser "Marseillaise," commissioned for her trials on the 10th ult.; although laid down after her sister ship the "Gloire," building at Lorient, she will be completed considerably in advance of her; she was launched just 18 months ago. The work of reconstruction of the second-class battle-ship "Dévastation" is also so sufficiently far advanced that gunnery and torpedo officers have been appointed to her to supervise the work now being completed, appertaining to their respective branches.

Lorient.—The new first-class armoured cruiser "Condé" was launched on the 12th inst. Her dimensions are as follows:—Displacement, 10,014; beam, 20·20 metres (66 feet); length, 138 metres (452 feet); 20,500-H.P.; speed, 21 knots; she has water-tube boilers and three propellers; she carries 1,600 tons of coal, giving a radius of action at 10 knots of 10,400 miles, and at full speed of 1,940 miles. She has a steel armoured belt and armoured deck of 150 mm. (5·9 inches) and 45 mm. (1·6 inches) respectively, and the turrets are protected with 150-mm. (5·9-inch) armour. The armament consists of two 194-mm. (7·6-inch), eight 164-mm. (6·4-inch), six 100-mm. (3·9-inch), eighteen 47-mm. (1·8-inch), four 37-mm. (1·4-inch) guns, and there are five torpedo-discharges, two of which are submerged. The complement will comprise 25 officers and 590 men, and the total cost is 22,855,066 francs (£914,202). She is to be completed by the end of 1904. The ship will take the water 55 per cent. completed, her 28 Niclausse boilers are almost all in place, and the fixing of her screw shafts is completed. Her place on the slip is to be taken by C14, one of the large armoured cruisers of the "Léon Gambetta" class, and the two principal officials of the Construction Department, who are to superintend her building, have been sent to Brest to make themselves acquainted with the methods being followed in the "Léon Gambetta."

The new second-class cruiser "Jurien de la Gravière" has at last received her complement of men in readiness for her trials, which are to commence immediately; they will be followed with much interest, as the ship has been designed for 23 knots, but it is hoped this speed will be much exceeded. The first consignment of the engines of the new first-class cruiser "Gloire," which are being made by the Creusot firm, has arrived in the yard, and the work of setting them up will proceed immediately. The remainder of the armament of the new armoured cruiser "Amiral Gueydon" has also been received, and is being mounted.

Toulon.—The new first-class cruiser "Chateaurenault" has commenced her official trials. During a 6 hours' run, the engines developing 18,400-I.H.P., a mean speed of 21·9 knots was obtained with a coal consumption of 643 gr. per H.P. per hour. During a 24 hours' run, the engines under natural draught developed 14,800-I.H.P., the side engines making 114 revolutions and the central 110; for 2 hours the ship was run at full speed, the engines making 129 revolutions and developing 22,5000-I.H.P., speed not given. The engines are reported to have worked well, although a tube in one of the boilers burnt; towards the end of the fourth hour there was some diminution in the resistance of the central engine, which is attributed to the breaking of one of the blades of the screw. M. de Guenic, the well-known writer on engineering matters, comments severely on the unsatisfactory nature of the trials to which French ships are subjected, and calls attention to the much severer trials to which new ships are subjected in England, instancing that while the French naval authorities are content with a 6 hours' run at four-fifths power, in England the run under similar conditions is for 30 and sometimes 60 hours; the full-power trial being for eight hours, instead of for two, as in France.

The first-class battle-ship "Masséna" arrived here on the 26th February, after a fine passage of 6 days from Brest; she has relieved the "Amiral Baudin" in the Reserve Squadron, which will now consist of the first-class battle-ships "Brennus," "Carnot," and Masséna," with the first-class armoured cruiser "Amiral Charner." The "Amiral Baudin" has been paid off into the 2nd Category of the Reserve.

The first-class battle-ship "Magenta," the school of seamen-torpedo-men, having had the repairs effected to her boilers, has returned to her usual anchorage off Salins d'Hyères.

Hygiene and the Accommodation of the Crew on board Modern Battle-ships.—Great efforts have lately been made in the French Navy to better the hygienic condition of the men's quarters in ships; and quite recently the Minister of Marine, with a view of checking the spread of tuberculosis, has directed the fitting on board large ships of disinfecting stoves, and he moreover appointed a Special Commission to enquire into and to report and make any official recommendations which may be necessary to improve the habitability and hygienic conditions of the new war-ships, as also upon the medical arrangements for looking after the health of the crew in times of peace, and the care of the wounded in action. The following is a *précis* of the report of the Commission, with certain recommendations which they consider should be adopted, after a careful investigation of the arrangements on board the "Suffren," our latest battle-ship.

The Commission first enquired into the sleeping accommodation, and reports that practically the whole crew sleep above the armoured deck, under the forecastle, and on the battery deck. The number of sleeping berths, with the air space, is as follows:—Under the forecastle, 291 men, with 3,670 cubic metres of air space; in the battery, 239 men, with 5,730 cubic metres, and on the main deck 53 men, with 7,620 cubic metres. The sleeping quarters are ventilated naturally by the hatchways, screens properly placed protect the men from draught, but do not prevent the free circulation of fresh air. The sanitary arrangements of the ship have been well carried out. A lavatory, with 41 basins, for the petty officers is fitted just forward of the foremost turret, on the forecastle deck, with, in addition, four fresh-water douche baths. On the spar-deck there are basins and towels for the 250 men, who have not access to the petty officers' and stokers' and artificers' lavatories. The shower-baths have a douche lasting a minute and a half. The parts of the ship where the crew sleep are warmed with steam pipes, and there are also two drying closets for the men's clothing. The lavatories for the artificers and stokers are on the armoured deck, one placed forward in one of the compartments, and the other two in two of the after compartments: they provide altogether 43 basins and 10 douches. The officers' and men's galleys and the bakery are on the spar-deck round the foremost funnel, and the arrangements are adequate for properly providing the admiral's table, should one be on board: the oven can bake in nine hours enough bread for each day's supply, the kneeding-trough being worked either by hand or electricity, and producing in about a quarter of an hour 240 lbs. of dough. The arrangements for the treatment of the sick in time of peace are as complete as possible: the sick-bay is placed forward, and there are 14 beds, or two for every hundred men of the crew, and there is a bath-room attached, fitted with hot and cold douches, of fresh or salt water, and a stove properly fitted for disinfecting bedding. Adjoining the sick-bay proper accommodation can be found if necessary for an additional 8 cots, and annexed is also an operating-room, fitted with operating and dressing tables, etc. Special means have been provided for removing bed-ridden cases

to the shore hospitals, and in case of an explosion in boiler or engine room a system of hoists for bringing the injured up has been arranged.

The Commission, having studied the best arrangements for treating the wounded, both in France and abroad, has made the following arrangements :—

1. Before an action, all the necessary medical material to be placed at some central position, where 32 wounded can be received, and also at two secondary stations, one forward for 8 wounded, and one aft for 18, all three positions being under armour protection.

2. During an action, the wounded to be provisionally placed temporarily where they will least interfere with the men fighting the guns ; during the first lull in the action under the orders of the officer in command, the doctors and their attendants will be summoned to the battery deck, and the wounded will be removed below the armoured deck ; the badly wounded being transported to the principal surgical station on movable platforms, enabling them to be kept in a horizontal position, the less serious cases going to the secondary stations. The dressing of wounds will take place at all three stations, but surgical operations will, if possible, be deferred until after the action.

The arrangements proposed are based on the supposition that an action will last about three hours, and that in a ship like the "Suffren" some 120 people will be wounded : about 35 in the first hour, 60 in the second, and 25 in the third. We regret that space will not allow us to give in detail all the ingenious arrangements fitted in the "Suffren," with the object of reducing to a minimum the sufferings of the wounded while being removed, but what has been done in that ship is a sufficient guarantee of the medical care being taken of the men who man our Navy.—*Le Yacht*, *Le Temps*, and *Le Moniteur de la Flotte*.

NORWAY.—*Naval Estimates.*—The Estimates for the Norwegian Fleet for 1901-02, compared with those of the previous year, are as follows :—

	1901-02.			1900-01.		
	Crowns.	£	s.	Crowns.	£	s.
Vote 1.—Admiralty and General Staff ..	75,000	= (4,166	13)	55,000	= (3,055	11)
Officers of the Military Branch ...	277,000	(15,388	6)	274,000	(15,222	4)
Medical Corps	45,000	(2,500	0)	37,000	(2,055	11)
Petty Officers and Men	338,000	(18,777	15)	354,000	(19,666	13)
Artificers, including the *Personnel* of the Mine Defences	427,000	(23,722	4)	396,000	(22,000	0)
Accountant Branch	75,000	(4,166	13)	75,000	(4,166	13)
Administration of the Dockyards ...	151,000	(8,388	17)	159,000	(8,833	6)
Vote 2.—Naval Schools	390,000	(21,666	13)	361,000	(20,055	11)
Vote 3.—Training and Training Cruisers, including a sum of 30,000 crowns (£1,666 13s.) for Mobilisation ..	1,067,000	(59,277	15)	1,045,000	(58,055	11)
Vote 4.—New Ships	250,000	(13,877	15)	800,000	(44,444	9)
Maintenance of the Fleet	185,000	(10,277	15)	143,000	(7,944	9)
Submarine Mine Defences	100,000	(5,555	11)	34,000	(1,888	17)
Guns	150,000	(8,333	6)	197,000	(10,944	8)
Hospital Service	19,000	(1,055	11)	17,000	(944	8)

Maintenance of Construction :—	1901-02. Crowns.	£	s.	1900-01. Crowns.	£	s.
Matériel	168,000 =	(9,333	6)	153,000 =	(8,500	0)
Dockyards	292,000	(16,222	4)	270,000	(15,000	0)
Totals	4,009,000	(222,710	4)	4,370,000	(242,777	11)

New district commandants have been created for Carljohansv, Christiansand, and Bergen. The new construction only comprise two torpedo-boats and the completion of an 850-ton despatch-vessel.—*Mittheilungen aus dem Gebiete des Seewesens.*

SWEDEN.—*Naval Estimates, 1902.*—The Swedish Naval Estimates for 1902 amount to 10,461,982 crowns (£581,221 5s.) for the Ordinary Budget, and 10,983,013 crowns (£610,169) for the Extraordinary, showing an increase over the previous year of 2,331,027 crowns (£129,501 10s.) in the Ordinary Budget, and a decrease of 2,439,062 crowns (£135,503 9s.) in the Extraordinary.

The following are the principal items in the Ordinary Budget :—

	Crowns.	£	s.
1. Ministry of Marine	93,400 =	(5,188	17)
2. *Personnel* of the Fleet	3,851,740	(213,985	11)
3. *Matériel*	1,685,000	(93,611	2)
4. Ships in commission and instructional cruiser	1,361,900	(7,566	2)
5. Naval schools	53,470	(2,970	11)
6. Medical department and hospitals	44,000	(2,444	9)
7. Coast Artillery	1,479,496	(82,194	4)
8. Divers' expenses	1,479,496	(82,194	4)
9. Mercantile marine	1,688,209	(93,789	7)

Out of the Extraordinary Budget, 8,932,765 crowns (£496,264 14s.) are devoted to the service of the Fleet proper, of which 6,639,915 crowns (£368,884 3s.) are for war *matériel*; 280,00 crowns (£15,555 11s.) for the reconstruction of the monitors "Thordön" and "Tirfing"; 107,900 crowns (£5,994 8s.) for the conversion of certain torpedo-boats into vedette-boats; 1,206,000 crowns (£67,000) as the second credit for the guns and torpedoes of the battle-ships "A," "B," and "C"; 15,000 crowns (£833 6s.) for gunnery trials; 5,000 crowns (£277 15s.) for torpedo trials; 80,000 crowns (£4,444 9s.) for the purchase of reserve torpedo *matériel*; 50,000 crowns (£2,777 15s.) for the purchase of submarine mines; 50,000 crowns (£2,777 15s.) for boom *matériel*; 290,000 crowns (£16,111 2s.) for coal, and 105,000 crowns (£5,833 6s.) for clothing, these two last items being in connection with mobilisation. In the credit of 6,639,915 crowns (£368,884 3s.) for war *matériel* are included the sums required for new ships, divided as follows :—1,835,865 crowns (£101,992 10s.) for the completion of battle-ships "A," "B," and "C"; 598,050 crowns (£33,225) as first vote for 3 first-class and 2 second-class torpedo-boats, and a torpedo-boat destroyer: 2,813,000 crowns (£156,277 15s.) as first vote for the construction of a first-class battle-ship; and 181,000 crowns (£10,055 11s.) for a balloon-ship. The Admiralty has also entered into a contract for a 31-knot destroyer, to be of the most modern type, and to be provided with the necessary fittings for burning petroleum fuel.—*Mittheilungen aus dem Gebiete des Seewesens.*

New Ships and Dockyard Notes.—The new coast-defence battle-ship "Dristigheten" has satisfactorily concluded its steam trials, having under forced draught attained a speed of 17 knots. Her principal dimensions are as follows :—Length, 285 feet; beam, 48 feet 7 inches; draught, 16 feet on a displacement of 3,450 tons. Her engines were to

make 6,000-I.H.P. under forced draught, and 5,400-I.H.P. under natural, the speed being 17 and 16·5 knots respectively, which has been reached at the trials. Steam is generated by twelve Yarrow water-tube boilers, with a grate-surface of 136 square feet, and a heating surface of 4,712 square feet. The cylinders have a diameter of 724 mm. (28·66 inches), 1,133 mm. (44·6 inches), and 1,755 mm. (69·1 inches) respectively, with a stroke 693 mm. (27·7 inches). The steam pressure is 14·7 kg. (32·34 lbs.) per square centimetre

Protection is afforded by an 8-inch water-line belt, tapering to 4 inches at the extremities, the plates having been made at the St. Chamond and Krupp Works; the central citadel for the secondary armament is protected by 4-inch armour, and the turrets for the two heavy guns by 8-inch plates in front and 6-inch in rear; the armoured deck is 2 inches thick and the conning-tower 8 inches. The armament consists of two 8·2-inch 42-calibre Bofors guns, one in each turret forward and aft: six 5·9-inch 45-calibre Q.F. Bofors guns in the central battery with splinter bulkheads between, fifteen 6-pounder Q.F. guns, and two submerged torpedo-tubes, Elswick pattern.

The three coast-defence battle-ships A, B, and C were all launched last year, receiving the names of "Tapperheten," "Vasa," and "Acran" respectively, they are all three to be completed for sea during the present year. They are 200 tons larger than the "Dristigheten," with 2 feet greater length, 8 inches more beam, and a draught increased 5 inches on a displacement of 3,650 tons. The I.H.P. and speed remain the same as in the earlier ship. The armament also remains the same, but the six 5·9-inch Q.F. guns are carried in single turrets instead of a central battery, which are protected by 6-inch plates in front and 2·5-inch behind. The thickness of the armour plates has been somewhat reduced, but their resisting power remains the same, the extreme thickness of the belt being only 7 inches; the armour on the fore turret is 7·8 inches thick, and on the after 5·8 inches, the lower barbettes being 7·8 inches. The small revolving turrets for the 5·9-inch Q.F. guns are protected by 6-inch armour, tapering to 2·4-inch in the rear, while their barbettes are of 4-inch steel. The armoured deck is 2 inches thick, and the conning-tower 7 inches. The whole of the armour has been provided by Krupp, with the exception of that for the barbettes of the 5·9-inch guns, which has been manufactured by the Bofors Works in Sweden. The water-tube boilers are of the Yarrow type, and with the engines are the same as in the "Dristigheten."

The plans for a new coast-defence ship have been approved, the cost of which is to be 5,625,000 crowns (£312,500). She will differ from the earlier vessels in having the armoured deck somewhat thicker over the boilers, while the supporting and ammunition tubes for the turrets of the 5·9-inch Q.F. guns are to be strengthened, but at the expense of the turrets for the two heavy guns, which will have rather weaker armour. In view of the unfortunate delays, which have attended the delivery of armour in the past, with the exception of the plates for the armour deck and the ammunition and communication tubes, the contract for the armour will be given to Krupp.

The work of re-constructing the three old coast-defence ships, built between 1886 and 1892, viz., the "Svea" of 2,900 tons and 14·7 knots speed, the "Göta" of 3,100 tons and 16 knots speed, and the "Thule" of 3,150 tons and a 16·2 knots speed, is now almost completed, and the ships should be ready for their trials this spring. In place of the earlier armament of two 25-cm. (10-inch) Elswick guns in a single turret forward, and four unprotected 5·9-inch guns, the ships will now carry one 8·2-inch Q.F. gun in a turret forward, three 5·9-inch Q.F. guns in single turrets on each broadside, and aft, also in a turret, another 5·9-inch Q.F. gun, while eleven 6-pounder Q.F. guns will be distributed on the upper deck and bridges. The cost of modernising these three ships will amount altogether to 4,920,000 crowns (£273,333 6s.).

The two old monitors "Thordön" and "Tirfing" are to receive two 4·7-inch guns, and the first-named eight 3-pounder Q.F. guns, and the latter eight 6-pounder Q.F. guns. Both ships have a displacement of 1,500 tons, while the smaller monitors, "Sölve," "Folke," and "Hildur," are to receive each one 4·7-inch Q.F. and two 6-pounder Q.F. guns.

The first torpedo-boat destroyer for the Swedish fleet is being built by Messrs. Yarrow at Poplar. With a length of 220 feet, a beam of 20 feet, the vessel will have a displacement of 320 tons. The contract speed is to be 31 knots during a three hours' trial under forced draught, with a 3-inch air pressure and 35 tons extra lading. The vessel is divided into 7 water-tight compartments, and her armament consists of six 6-pounder Q.F. guns, and two torpedo discharges. She has two four-cylinder triple-expansion engines, steam being supplied by four Yarrow boilers, which are protected by the coal-bunkers. She is to cost £48,300, with a premium of £500 for each quarter of a knot over the contract.

The Personnel.—The vote for the *Personnel* provides for an increase of 50 officers, 53 petty officers, 350 men, and 80 boys. This gives a total of 210 officers, 362 petty officers, 2,825 men and 400 boys.—*Marine-Rundschau.*

SWEDEN.—*The Development of Smokeless Powders in Sweden.*—In a letter to *Engineering*, Mr. Ragnar Sohlman, of the Bofors Works, Sweden, says :—

"The interesting articles in your esteemed journal on the subject of American experiences in regard to the different kinds of smokeless powders, fully corroborate the similar results arrived at in Sweden.

"In this country nitroglycerin powders have been used by the Navy since 1892, and have of late been adapted also for certain heavy guns belonging to the coast defence ; whereas the Army is using principally a nitrocellulose powder, manufactured at the Government factory.

"Up to 1896, smokeless powder was used by the Navy only for the light Q.F. guns. That year it was adopted also for the new 12-cm. (4·7-inch) Q.F. guns.

"The nitroglycerin powder employed for these purposes was ordinary ballistite containing 50 per cent. nitroglycerin and 50 per cent. nitrocellulose of about 12 per cent. nitrogen. The heating and erosive effect of this powder is very much the same as that produced by cordite. By using a more suitable shape of the grain—*tubes* instead of *cords*—it was, however, possible to attain a satisfactory velocity without too excessive pressure, thus avoiding a too great erosive effect on the bore of these light guns.

"In 1897, during firing experiments carried out at Bofors with a 15-cm. (5·9-inch) Q.F. gun with very small chamber space, it was found that the heating effect of the powder was too considerable to make it suitable for a gun of this calibre. After a few rounds a considerable wasting away of the metal around the seat of the projectile was perceptible. After three rounds, using the same metal cartridge case, this was completely worn out at the edge, and could not be used further.

"It was then found necessary to alter the composition of the powder in order to obtain a lower temperature of combustion, and, consequently, less corrosive effect.

"This aim was arrived at by lessening the percentage of nitroglycerin to 25 per cent. and using a 'moderant,' which is at the same time a solvent for nitroglycerin and nitrocellulose. In this way it is easy to obtain a composition giving even a lower development of heat and larger volume of gas per unit of weight than a pure nitrocellulose containing a low percentage of nitrogen, such as, for instance, the German Troisdorf powder.

"To prove this, the following results obtained by calorimetric test of the two powders may be cited: -

Kind of Powder.	Heat units per gram.	Volume of gas of combustion.			Heat volume of gas per gram.[1]
		Permanent	Aqueous.	Total.	
Nitroglycerin powder (yield-11·27 per cent. N.[1]) ...	922	813	165	978	901·7
Troisdorf powder (yielding 11·98 per cent. N.[1]) ...	943	750	172	922	870·5

[1] Nitrogen determined by nitrometre.

"As will be observed, the nitroglycerin powder is capable of performing a slightly greater amount of work per unit of weight, under the same conditions, although the heat produced per gram is somewhat less.

"These theoretical calculations have been upheld by actual experience, the modified nitroglycerin powder having given satisfactory results in various heavy guns, up to such of 25·4-cm. (10-inch) calibre.

"The experience in Norway, where a similar nitroglycerin powder is used by the Army as well as by the Navy, for guns of all calibres, and also for the Army rifle, seems to be very much the same as in Sweden. Since 1893, when the powder was first introduced into the Service, no serious complaints have been made against it.

"In taking cordite as the representative type of powders containing nitroglycerin, as has been done by the author of a paper which appeared on 8th March in your journal, and condemning the whole class on account of the demerits of cordite, a great injustice is certainly done towards the more modern types, which do not share the same faults. For it can hardly be denied that cordite is in several respects an antiquated powder, however great may have been its merits at the time of its first appearance, and even then these merits were disputed.

"Thus, the *cord* shape is not by far comparable to the *tube* or *multiperforated grain*, when a high ballistic effect with moderate pressure is desired.

"Further, the use of insoluble nitrocellulose, together with a moderant—vaseline—which is not a solvent, either for nitroglycerin or for nitrocellulose, causes serious disadvantages, which are still further aggravated by the excessive percentage of nitroglycerine contained in the powder. By exposing cordite to heat and pressure, it is easy to cause the nitroglycerin to separate from the nitrocellulose in a way very similar to the squeezing out of water from a wet sponge. It is all put possible that the same phenomena occur, at least partly, in the combustion of cordite in a gun. If this be so, the nitroglycerin will burn slightly quicker than the nitrocellulose and vaseline, producing a higher temperature in the beginning of combustion of the charge than the composition of the powder and the calorimetric *data* would indicate.

"A further disadvantage of cordite, which does not exist with the low percentage nitroglycerin powders containing soluble nitrocellulose, is the exudation of nitroglycerin, which takes place at a low temperature.

"The main advantage of the nitroglycerin powders are, in the view of your correspondent, their absolute freedom from porosity. A nitrocellulose powder, containing a few per cent. of volatile solvent, is apt to lose part of this during prolonged storage. The evaporation of the solvent will cause a tendency of the interior of the grains to contract. As the surface is hard and brittle, the grains will be

exposed to internal stresses which may, under unfavourable conditions, cause their breaking up in the bore of the gun, thus producing an excessive pressure.

"In the evaporation of the solvent a certain porosity is unavoidable. This porosity causes a certain hygroscopicity of the pure nitrocellulose up in the bore of the gun, thus producing an excessive pressure.

"The advantages claimed for the pure nitrocellulose powders are a high degree of chemical stability and low temperature of combustion. As it seems, however, quite feasible to arrive at the same results, and gain other very important advantages, with a nitroglycerin powder containing a low percentage of nitroglycerin, such powders will probably, as is also pointed out by Mr. Willcox, prove the most satisfactory for the future."

Mr. Sohlman's first paragraph refers to a long article by Mr. F. A. Willcox, B.Sc., which was published in *Engineering*. Taking as a guide rather old experiments made by our Army Ordnance officers, Mr. Willcox reaches the conclusion that the best smokeless powder is likely to be one in which there is a moderate amount of nitroglycerin (say not over 25 per cent.) combined with gun-cotton. That our Army Ordnance officers have not arrived at the same conclusion is apparent from the report of the Chief of Ordnance.—*Proceedings of the United States Naval Institute.*

UNITED STATES.—*Tests and Descriptions of U.S. Naval Guns.*—The following descriptions and tests of U.S. naval guns, 3-inch, 4-inch, 6-inch, and 12-inch, are furnished by Lieutenant W. G. Turpin, U.S.N., recently Assistant Inspector of Ordnance at Indian Head.

Naval 12-inch 40-calibre Gun: Trials and Remarks upon Gun and Mount.—This is the latest design of 12-inch guns, and is designed to give 2,800 foot-seconds with a chamber pressure of 17 tons, using a suitable smokeless powder. The principal advance over the older guns is the increased initial velocity and consequent increased energy of the projectile. Two things produce these results: the increased length of the bore and the increased size of the powder chamber, the latter of which is most important.

The mount, like that of all recent guns, is of the spring-return type, having four recoil cylinders, each of which contains a set of springs to return the gun to battery. The gun proper is without trunnions and recoils in the line of fire in a sleeve which carries the trunnions, elevating gear, and recoil cylinders.

The breech mechanism is an adaptation of the Fletcher-Farcot mechanism to the Welin block. The stepped slotted screw, owing to greater portion of the circumference (three-fourths in this gun) bearing, permits a shorter block and reduces the time of opening, as the necessary angle of rotation and length of translation (retraction) are both less.

The gas check is of the De Bange type, with split rings instead of discs. The firing lock is of a new type (Mark VIII.), in which the opening of the lock automatically ejects the old primer; it is designed to use the combination primer. The elevating gear is of the usual type for these guns and can be operated either by hand or power.

The following are the ballistic results of firing one sample of smokeless powder, using the ordinary 850-lb. projectile :—

Round.	Charge.	Pressure.	Muzzle velocity.
	Lbs.	Tons.	Foot-seconds.
1	240	5·95	1913
2	280	9·35	2123
3	304	10·9	2344
4	328	13·0	2531
5	350	15·5	2770
6	360	16·5	2837
7	370	18·0	2885
8	376	20·5	2899

Naval 6-inch 50-calibre Gun: Trials and Remarks upon Gun and Mount.—This gun is similar to the 5-inch of the same length. The breech mechanism is exactly the same. The piece is designed to give a velocity of 3,000 foot-seconds, with a pressure of 17 tons in the chamber. The velocity in service is fixed at 2,900 foot-seconds.

The mount is of the pedestal type, being somewhat modified from the earlier designs to withstand the increased energy of the gun. The latter is trunnionless, recoils in a sleeve and is returned to battery by springs. The recoil cylinders are two in number and are placed under the gun. The cartridge case has been discarded and the charge put up in a bag. The modified De Bange type of gas check is used. The lock is arranged for electric or percussion firing and automatically ejects the old primer case when the breech is opened. In case of failure of the primer the gun can be cocked without opening the breech.

The elevating and training gears are of the usual type and are convenient to the gun firer, who stands on a platform revolving with the gun.

The following are some of the results of firing :—

Rounds.	Charge.	Pressure.	Muzzle velocity.
	Lbs.	Tons.	Foot-seconds.
1	33	7·45	2141
2	36	8·9	2325
3	40	11·95	2577
4	44	14·5	2822
5	45	15·35	2848
6	46	16·15	2935
7	46·5	16·35	2955
Tests of another sample :—			
1	30	7·8	2153
2	35	9·83	2365
3	40	12·4	2677
4	43	14·4	2821
5	44·5	15·3	2850
6	45	15·8	2932

Naval 4-inch 50-calibre Gun: Trials and Remarks upon Gun and Mount.—In this gun the brass cartridge case is retained and the projectile is made up in one with the powder. The powder is enlarged as in the other guns, and this necessitates a bottle-shaped case. Like the other 50-calibre guns, this is designed for a velocity of 3,000 foot-seconds, with a chamber pressure of 17 tons, but the service

velocity is fixed at 2,900 foot-seconds. The gun recoils in a sleeve and is returned to battery by springs in the two recoil cylinders, which are placed underneath the sleeve. The mount is of the pedestal type. The breech mechanism is the modified Fletcher-Farcot and operates a Welin breech plug, which has two blanks and four threads. The plug is carried in a collar, but does not have to be retracted before the breech is open, but is swung directly out as soon as unlocked. The extractor is carried on the front end of the block in a manner somewhat similar to that of the Dashiell. Electric or percussion firing can be used, the change being made by shifting a small catch. The primers in the cartridge cases are all of the combination type. The following are some of the ballistic results obtained with this gun, using a 32-lb. shell :—

With another lot of powder :—

Round.	Charge.	Pressure.	Muzzle velocity.
	Lbs.	Tons.	Foot-seconds.
1	12	9·1	2,200
2	14	12·8	2,586
3	15	14·35	2,761
4	15·5	15·9	2,891
5	16	16·4	2,943
With another lot of powder :—			
1	10	4·65	1,831
2	13	8·1	2,343
3	15	12·1	2,751
4	15·5	14·3	2,899
5	16	17·4	3,039
With third lot of powder :—			
1	10	6·3	1,893
2	12	8·7	2,201
3	13	10·3	2,363
4	15	13·3	2,717
5	15·5	14·2	2,805
6	16·1	15·15	2,903
With fourth lot of powder :—			
1	12	9·7	2,315
2	14	13·0	2,657
3	15	16·0	2,922
4	15·5	16·3	2,972
5	15·75	16·7	3,003
With fifth lot of powder :—			
1	14	13·0	2,668
2	15·5	16·4	2,982
3	15·75	18·2	3,079
With sixth lot of powder :—			
1	15	16·6	2,931
2	15	16·3	2,898
3	15·5	17·6	3,046
4	16	19·0	3,155
5	16·15	20·2	3,204

All these results are good except, perhaps, the first, which was a little too slow burning for the gun. The second and fifth samples gave excellent results as regards both pressure and velocity. The last sample showed a high ballistic efficiency per pound, but the pressures were high.

Naval 3-inch 50-calibre Gun: Trials and Remarks upon Gun and Mount.—This gun, like the 4-inch, has a bottle-shaped brass cartridge case with the charge and projectile in one. Like all of the 50-calibre guns, it is designed to develop 3,000 foot-seconds velocity, with 17 tons pressure in the chamber. The service velocity is fixed at 2,800 foot-seconds. The gun recoils in a sleeve. The recoil cylinders, two in number, are placed under the gun and contain the liquid and counter-recoil springs. The breech mechanism differs somewhat from that of the larger guns, as the step system is not used. The plug has no motion of translation to the rear, but is swung out as soon as unlocked. This is effected by cutting away in the arc of a circle the blanks of both plug and screw box, which are farthest from the hinge of the plug. This latter is not carried in a collar, but its rear end is held in a plate which closes the breech, and is hinged like the usual plug collar. The later types have a catch to prevent the rebound of the plate when closing the breech. The plug is rotated by means of a small rack sliding in the breech plate, resembling that in the Dashiell mechanism. The firing mechanism is for percussion, and the lock can be cocked when the breech is closed. The case is not ejected entirely by the extractor; that is, it is not violently thrown out—it may be fully ejected if the gun is slightly elevated. The gun is trained and elevated by mechanism, as it was found to be too heavy for training and elevating with a shoulder piece. No rapidity tests were made, but it can be loaded and fired much more rapidly than is consistent with accurate firing. The endurance of these guns seems to be ample. Several have been fired a large number of times. One has been fired 376 times with high velocities and pressures—the latter ranging from 13 to 19 tons—and it shows no signs of wear or erosion. The following are some of the ballistic results attained with the service 13-lb. projectile :—

Rounds	Charge.	Pressure.	Muzzle velocity.
	Lbs.	Tons.	Foot-seconds.
1	4	9·6	2,337
2	4·5	13·0	2,710
3	5	14·75	2,841
4	5·1	15·4	2,915
5	5·2	16·3	2,942
With another sample of powder :—			
1	4	8·7	2,109
2	4·5	10·75	2,331
3	4·75	11·9	2,470
4	5	13·0	2,590
5	5·2	13·65	2,656
6	5·4	14·7	2,778
7	5·6	16·55	2,858
With a third lot of powder :—			
1	4·75	11·9	2,534
2	5	14·8	2,796
3	5·1	14·8	2,824
4	5·2	15·8	2,870
5	5·3	16·5	2,902

Of these samples the first was much the best.

Brown 10-inch Wire-wound Gun: Breech Blown Off; Description of Gun.— This gun, which was recently completed, gave way at the ninth round while under test at Sandy Hook Proving Ground on 28th October. The jacket yielded near the forward end of the screw box, its rear end containing the breech plug being driven to the rear with such force that it struck and wrecked a concrete structure, 200 feet in rear, on which lay several unmounted mortars. The shock of striking the concrete broke in two the ring of the jacket which had been broken off. [This is an excellent commentary on the character of the jacket metal.] The breech block and bushing surrounding it were practically uninjured. Mr. J. N. Brown and Mr. H. M. Munsell, trustees of the Brown gun, attribute the giving way of the jacket to the failure of the De Bange gas check, whereby the whole forward surface of the plug and breech, bushing was exposed to the powder presence. This is possible, but unlikely. A properly constructed De Bange gas check, having suitable steel rings, acts better and obturates more perfectly with a high pressure than with a low one; one that fails must be very poorly constructed. And an ordinary failure to obdurate perfectly would not allow the gas to escape fast enough to create a high pressure behind the gas check. The most likely cause of failure was that the cast-steel jacket was of insufficient strength. Cast steel is very uncertain in its behaviour. Its power to resist very sudden stress is not to be measured by methods that are accurate enough with forged metal. The behaviour of the ring of metal pulled off the jacket shows it must have been very brittle and of slight tenacity or it ought not to have broken when it struck the concrete. For twenty years cast steel has been discarded as a gun metal, and it is hard to understand why the designers of the Brown gun should jeopardise their work by using it. It is by the incorporation of such ill-considered features that many otherwise good inventions have failed. The compiler is opposed to all systems of wire-wound guns in the present condition of gunpowder development as affording no *useful* addition to the transverse strength of the piece, while in all systems of wire-winding the longitudinal stiffness is seriously impaired. Now longitudinal stiffness is necessary to insure accuracy and reduce the amplitude of the lateral vibrations in the long guns of the present day.

So far as can be judged from theoretical considerations and the tests as far as shown, the Brown gun is probably as good as any wire-wound piece. If the segments can be so closely fitted as to bring their full elastic strength into play, the discontinuity of the metal must tend to check vibration in the chase. But the close fitting of the segments must be a difficult matter, for the friction which is relied upon to enable them to exert their strength in a transverse direction must resist the squeezing effort of the wire to bring them into proper position.

The Brown gun has frequently been described, and the compiler intended to furnish a section of the gun in the notes for this number of the *Proceedings*, but the drawing was accidentally omitted. It consists of a thin tube surrounded by a segmented body. Over this is wound several layers of wire. Over the wire a thin casing of steel covers the chase and a jacket, with its front end reaching over the rear end of the casing, extends far enough beyond the breech face of the tube to form a housing for a breech ring, or bushing, in which is formed the screw box. The segmental core for the 5-inch gun (and it is similar for the 10-inch) consists of eighteen sheets of steel 19 feet long, 24 inches wide at one end, 6 inches at the other, and one-seventh of an inch thick. The manner of combining them may best be illustrated as follows: Imagine sheets of elastic cardboard of these proportions (say one-twelfth of the dimensions given) laid in a pile so that the edge of each is set back slightly from the edge of the one beneath it. Hold the

sheets so that they will not slide upon each other, and roll them up into a slightly conical tube about half an inch in inside diameter. If the sheets were properly placed before rolling, the outer edges of the cardboard will show at equal distances around the circumference. Now smooth out the interior of the tube by smoothing down the edges of the cardboard until the interior is a perfect cylinder. In the actual gun the sheets are put together in this way but are shaped before being assembled. After the segments are in place, numerous clamps are put on to hold them together and the tube inserted by hydraulic pressure. The wire is then wound on with a tension of 26,000 lbs. but as the cross-section is small this is equal to a stress of 128,000 lbs. per square inch. The end of the wire is secured by means of a metal plug in a hole in the first shoulder of the muzzle ring, thence to the breech and back to the muzzle again. The second layer begins at the second shoulder and is similarly wound as are the remaining layers. The chase jacket is then forced on by hydraulic power and a threaded muzzle cap or ring screwed on. The jacket is then shrunk on, the lining tube bored and rifled, and the breech bushing fitted and slotted to receive the breech plug.

Gathmann Gun Test: Failure to Achieve Results Expected by Inventor.—Strictly speaking, this was a projectile test; but as it involved the whole Gathmann system, including gun, powder, and projectile, it has been placed under the head of "Guns: Firing." Only newspaper accounts of the test are as yet available. And many interesting points are not touched upon. The inventor claimed that the gun would develop a muzzle velocity of 2,100 foot-seconds with only 20,000 lbs. maximum chamber pressure. This the compiler regarded as absurb. The newspaper accounts do not give the velocity attained, but say that the muzzle energy was 40,000 foot-tons. This would mean a muzzle velocity of about 1,800 foot-seconds, which is probably all the gun is capable of safely developing.

The target was a steel armour plate supported by the same sort of structure as is found behind it in ships. In rear of this, and bracing it to receive the blow, were heavy pieces of timber driven deeply into the earth, and in rear of this again a heavy sand butt. The plate was of Krupp face-hardened steel, made at the Carnegie armour factory, and its dimensions were:—16 feet by 7·5 feet by 11·5 inches. The weight of the Gathmann shell was 1,860 lbs. Its probable striking velocity, a little less than 1,800 foot-seconds. In the first trial, 15th November, the projectile struck the plate near the centre, dishing it about 2 inches at the point of impact, but not otherwise injuring it or its supporting structure. On 16th November two more shots were fired at the target. The first struck in the right side of the plate about half way from the centre to the edge. The only effect was to force the right edge of the plate backward a few inches. The other shot was directed at a similar point on the left side of the centre. It buckled the framing behind the armour considerably and set back the left edge of the plate about 18 inches. Mr. Gathmann admitted that the results were not up to his expectations, but thinks they warrant further experimentation: and that if it had been a battle-ship which was struck, the shock of the explosion would have put her out of action. In this he is certainly mistaken. Not even the crushing of the plate into several pieces would necessarily put the ship out of action.—*Proceedings of the United States Naval Institute.*

MILITARY NOTES.

PRINCIPAL APPOINTMENTS AND PROMOTIONS FOR FEBRUARY, 1902.

Lieut.-Colonel M. C. Cooke-Collis, I.S.C., to be Colonel. Colonel Sir E. G. Barrow, K.C.B., I.S.C., is granted the temporary rank of Major-General whilst Secretary to the Government of India, Military Department. Lieut.-Colonel (temporary Colonel) E. M. Baker, now an A.A.G., to have the substantive rank of Colonel in the Army. The under-mentioned officers are granted the local rank of Colonel in South Africa, whilst commanding columns, viz. : Lieut.-Colonel J. S. S. Barker, R.A., and Lieut.-Colonel A. E. W. Colville, the Rifle Brigade (the Prince Consort's Own). Major and Brevet Lieut.-Colonel W. H. Birkbeck, 1st Dragoon Guards, is granted the local rank of Colonel in South Africa, whilst Assistant-Inspector of Remounts. Lieut.-Colonel (temporary Colonel) P. H. N. Lake, now an A.Q.M.G. at Head Quarters, is granted the substantive rank of Colonel in the Army. Lieut.-Colonel and Brevet Colonel Sir J. Willcocks, K.C.M.G., D.S.O., is graded as a Colonel on the Staff whilst employed on special service in South Africa. Lieut.-Colonel W. J. Kirkpatrick, C.B., the York and Lancaster Regiment, to be Colonel. Lieut.-Colonel J. C. Harrison, retired list R.E. (Reserve of Officers), to be Colonel. Lieut.-Colonel C. E. Harman, h.p., to be Colonel. Major and Brevet Lieut.-Colonel the Hon. J. H. G. Byng, 10th Hussars, to be Colonel, in recognition of his services during recent operations in South Africa. Colonel H. D. Hutchinson, I.S.C., to be Assistant Military Secretary (for Indian affairs) at Head Quarters. Lieut.-Colonel J. F. Burn-Murdoch, C.B., h.p., to be Colonel. Lieut.-Colonel E. N. Henriques, R.G.A., to be Colonel. Lieut.-General and temporary General Sir H. Brackenbury, G.C.B., K.C.S.I., Colonel Commandant Royal Artillery, Director-General of Ordnance, to be General. Lieut.-General Sir W. Stirling, K.C.B., Colonel Commandant Royal Artillery, Lieutenant of the Tower of London, to be General.

HOME.—*Memorandum of the Secretary of State Relating to the Army Estimates for 1902-1903.*—The total of the Army Estimates for 1902-03 amounts to £69,310,000, while the number of men to be voted is 420,000.

The following table shows the comparison with the figures for the current year (including the Supplementary Estimate) :—

	1901-02.		1902-03.	
	Ordinary Services.	War.	Ordinary Services.	War.
Vote A (*personnel*)... ...	219,800	230,200	219,700	200,300
	450,000		420,000	
Votes 1-16	£29,685,000	£63,230,000	£29,310,000	£40,000,000
	£92,915,000		£69,310,000	
Decrease { Ordinary Services ...			£375,000	
Decrease { War Services ...			£23,230,000	

The net decrease of £375,000 on ordinary services is mainly accounted for as follows :—

INCREASES.

		£	£
1.	Increases due to policy already sanctioned by Parliament.		
a.	Volunteers. Capitation grants for additional number of efficients	50,000	
b.	Additional annuities payable on Works Loan	75,000	
c.	Net increase on non-effective votes for pensions, etc., caused by the war, after deducting a saving on normal charges	350,000	
d.	Imperial Yeomanry. The total increase to be voted was £600,000. For the current financial year only £300,000 was required...	300,000	
			775,000
2.	Increases due to changes now first proposed.		
	The principal measures are :—		
	The Provision for Additional Mounted Troops on Mobilisation : increase to the Army Ordnance Department : the seconding of officers while at the Staff College, and other miscellaneous increases		150,000
			£925,000

DECREASES.

		£
a.	Reduced strength of Army Reserve	90,000
b.	New Militia Reserve to be only partially raised	100,000
c.	Garrison Battalions. Only six will probably be raised during 1902-03	145,000
d.	Full number of Militia Battalions will not train	150,000
e.	Reduced provision for re-armament of fortresses at home and abroad	500,000
f.	Reduction on Works Vote	190,000
g.	Miscellaneous Decreases	125,000
		£1,300,000
	Net decrease	£375,000

War Services :—

The decrease under war services is made up as follows :—

South Africa	£21,420,000
China	1,810,000
	£23,230,000

As regards South Africa, the provision made is sufficient to maintain the field force at its present strength for between eight and nine months of the new financial year. In the case of China, provision has been made for the retention of a reduced force for about half the financial year, and also for the cost of the transport back to India.

Vote 1.—Pay, etc.

This vote shows a decrease of £4,123,000, of which £4,101,000 is for war and £22,100 for normal services.

There are various miscellaneous increases under this vote, but they are more than counterbalanced by additional receipts and a reduced provision for the Army Reserve, which is expected to be somewhat short of establishment on demobilisation.

Vote 2.—Medical Services.

The decrease on this vote amounts to £63,600, of which £50,000, is for war, and £13,000, for normal services. The decrease under normal is due to the fact that in the current year's Estimates the whole of the additional sum required for the re-organisation of the Army Medical Services was taken under this vote, whereas in the Estimates, 1902-03, the provision has been spread over the appropriate votes.

Vote 3.—Militia.

There is a net decrease of £1,391,000 on this vote, of which £1,239,000 is due to war and £152,000 to normal services. The decrease under the latter head is explained by the fact that a certain number of battalions, recently disembodied after considerable service, will not be called up for training this year, while reduced provision has been made for the new Militia Reserve, whose numbers are not expected to reach more than 25,000 men in 1902-03.

Vote 4.—Yeomanry.

There is a net increase of £210,000 on this vote mainly, due to the increased provision for the addition to the Force commenced last year.

Vote 5.—Volunteers.

The vote shows an increase of £57,000, but £7,000 of this amount is only nominal, representing a transfer of that amount from Vote 7 for messing allowance of the permanent staff. The balance of £50,000 is required for capitation and camp allowances to the increased number of efficient Volunteers.

Vote 6.—Transport and Remounts.

This vote shows a decrease of £6,735,000, of which £6,645,000 is for war services, and £90,000 for ordinary services. The decrease under the latter head arises mainly on purchase of remounts, the provision in 1901-02 having been in excess of normal requirements.

Vote 7.—Supplies.

The decrease on this vote amounts to £4,200,000, and arises entirely on war services, the total of the normal vote remaining the same as in 1901-02.

Vote 8.—Clothing.

The decrease on this vote is £855,000, of which £750,000 is for war, and £105,000 for normal services. The decrease under the latter head is mainly due to the fact that the vote for 1901-02 contained prime charges for the additions made last year to the Army, and also to the fact that, as stated above, it is not intended to train the full number of Militia battalions in 1902-03.

Vote 9.—Warlike Stores, etc.

This vote shows a decrease of £5,118,000, of which £4,600,000 is for war, and £518,000 for normal services. The latter decrease is mainly accounted for by the fact that reduced provision is required for the guns and ammunition for the re-armament of our fortresses at home and abroad.

Vote 10.—Works, etc.

This vote shows a net decrease of £1,091,000, of which £977,000 is for war services.

The normal vote for 1901-02 includes a sum of £210,000 for completion of hutting at home, which has now dropped out; but on the other hand there are increases of £75,000 for additional annuities under the Military Works Act, and £21,000 for services mainly of a sanitary nature, which reduces the saving on the normal vote to £114,000.

Vote 11.—Military Education.

This vote remains practically at the same figure as last year.

Vote 12.—Miscellaneous.

This vote shows a decrease of £116,500 on war and an increase of £9,100 on normal services. This is due to the establishment on a permanent basis of an Explosives Committee for experimental services (the cost of which will be shared by the Admiralty); the salaries are provided on this vote, there being charges for buildings and stores in other votes. There is also an increase in the sum to be taken for rewards to inventors.

Vote 13.—War Office.

This vote shows an increase of £27,000, of which £15,800 is due to the war and £11,200 to normal services. The increase under the latter head is accounted for partly by additions to the staff of the Military Departments and to the appointment of an Inspector-General of Artillery, and partly to the provision of the extra staff of the Accountant-General's Department required for the local audit of expenditure at the Head-quarters of I., II., and III. Army Corps.

Votes 14-16.—Non-effective Services.

These votes show as a whole a net reduction of £216,500.

The decrease in war services, which in the accompanying Estimates are limited to gratuities and other similar charges of a non-permanent nature, amounts to £566,500.

Permanent pensions arising out of the war are treated as normal services, and account for an increase under the head of £350,000.

ST. JOHN BRODRICK.

War Office,
6th February, 1902.

The following is a summary of the annual report of the Inspector-General of Recruiting for the year 1901, which has been issued as a Parliamentary paper:—

General Observations on Regular Army.—The total result of recruiting for the year amounts to 47,039 for the Regular Army, and 37,644 for the Militia. These figures are exclusive of the numbers raised for the Imperial Yeomanry for South Africa, Volunteer Service Companies, South African Constabulary, and other special units mentioned hereafter. The special measures adopted during the past year to either reinforce the Army in South Africa, or to relieve units or individuals therein serving, are as follows:—

"At the beginning of the year it was decided to raise additional drafts to reinforce the Imperial Yeomanry in South Africa. In consequence of this decision a Special Army Order was issued on the 17th January inviting members of the Home Yeomanry, ex-Imperial Yeomen, Volunteers, and civilians to enlist for one year, or if the war lasted longer, for the war. The men so enlisting were given the option, if the war was over in less than a year, of at once taking their discharge or of completing their year's service in South Africa. The rate of pay was fixed at 5s. a day for privates, and other ranks in proportion, this rate of pay being a consolidated rate to include messing and separation allowance. Married men and widowers with children were allowed to enlist, provided they agreed to allot one-third of their pay to their wives or children. In order to raise these drafts the old organisation of the Imperial Yeomanry formed in the preceding year was utilised. The total enlistments under these conditions amounted to 16,431, and by the end of April slightly over 16,000 men had embarked for South Africa. In accordance with a wish expressed by the Commander-in-Chief in South Africa, these drafts were sent out as soon as possible, without being trained at home. The original intention was to raise 5,000 additional Yeomen, but owing to the popularity of the Service, it will be seen that this number was largely exceeded. Recruiting ceased for the force on 9th March."

The following table shows the class of recruits enlisted :—

Enlistment from Yeomanry	622
,, ,, Volunteers	3,959
,, ,, Ex-Regulars	846
,, ,, Other Forces	597
,, ,, Civilians	10,407
	16,431

In addition to these Yeomanry drafts, it was decided to raise fresh companies of Infantry Volunteers to replace those serving in South Africa. Altogether 5,192 Infantry Volunteers were sent out, of which number 662 belonged to those companies raised in the preceding year. Special bounties were also offered to men in India to extend their service under the following conditions :—

A bounty of £10, with a furlough of two months at home, or £16 10s. in lieu of furlough, to all men who could claim to be passed to the Reserve on demobilisation, to extend their service to complete 12 years with the colours. Contrary to expectation, the number who availed themselves of the offer of furlough with bounty was only about 1,500, while the number who accepted the higher rate of bounty without furlough was about 15,112.

A special Army Order was issued on 23rd February, making provision for the creation of a Royal garrison regiment, to consist of battalions to be employed on garrison duty in the Mediterranean and at certain non-tropical stations. A number of other important experiments are still under trial, and need careful attention and record.

The Regular Army.—For the first half of the year under review, recruiting fell considerably below the numbers taken for the corresponding half of 1900. In July a change took place, and from that month recruiting, both for the Line and Militia, steadily improved, so that in spite of the fact that the enthusiasm caused by the war had to a certain extent waned, the total for the year is only slightly over 2,000 less than the preceding year, while the figures for the Militia are almost the same as in 1900. The same dislocation in recruiting agencies, caused by the embodiment of Militia battalions, again prevailed. The following table shows the number of units of Infantry Militia which were embodied and stationed abroad on 1st January, 1901, compared with those stationed abroad on 1st January, 1902, also the number of units returned home from abroad for disembodiment, and the number embodied in 1901 and despatched abroad :—

	Where Stationed.		Total.	
	South Africa.	Mediterranean.		
Embodied on 1st January, 1901	31	4	35	52
,, in 1901 and sent abroad	11	1	12	
,, at home prior to 1901 and sent abroad	4	1	5	
Disembodied on return home from service abroad	11	3	14	
Embodied and serving abroad on 1st January, 1902	36	2	38	

On the 1st January, 1902, in addition to the thirty-six infantry units mentioned above, there were serving in South Africa detachments of Mounted Infantry from nine-

teen Militia units. It will be seen that a certain number of Militia battalions have been disembodied on their return from abroad, but the services of their recruiters are not available for some considerable time for recruiting work, owing to the permanent staff having to clear up all the regimental accounts, clothing, etc.

In the report of last year the necessity of having a permanent irremovable cadre in each large recruiting centre was touched on. The matter has been again brought prominently to notice during the past year. In June last a circular was sent to all general officers commanding districts at home calling for a report regarding the special measures taken in their several commands for the conduct of recruiting during the present war, and for their suggestions should a similar situation again arise. It was pointed out that in considering this question general officers should remember that in the present case mobilisation had been gradual, and that this might not be so on future occasions. All general officers in their replies stated that there should be a special officer told off solely for recruiting duties in each district, and that this officer should not be the adjutant of the depôt. Officers commanding recruiting areas unanimously asked that a pensioner clerk should be appointed as recruiting clerk, at the headquarters of each recruiting centre. All laid great stress on the necessity of this, in order to have someone at headquarters not liable to removal on mobilisation and to maintain continuity. This is the more necessary as the recruiting officer is practically always the Militia adjutant, and is, therefore, taken away from his recruiting work on embodiment or annual training. All advocated the appointment of pensioner recruiters in the principal towns in each district.

It is regretted that recruiting for the Infantry of the Line continues to be unsatisfactory, the actual number of recruits enlisted during the year showing a further decrease of 352 compared with the numbers enlisted in 1900, the numbers enlisted during the latter year being a reduction from those taken in 1899. This continuous decrease, in view of the large number of new battalions added to the Army in recent years, is a matter for grave consideration. It is probable that the enlistment of large numbers of men for the South African Constabulary and the Imperial Yeomanry, with their high rates pay, has to a certain extent, injured recruiting for the Infantry of the Line. The continued embodiment of the Militia may also have affected recruiting to a certain extent for the Infantry.

Recruiting in Ireland for the Irish Guards has proceeded satisfactorily; and, generally, recruiting in Ireland has been the same as in the preceding year.

The enlistments for three years' colour service in the Infantry of the Line during the past year have amounted to 5,482, as against 3,322 in the previous year. In view of the continuance of the war, no restriction whatever has been placed on these enlistments for the Infantry of the Line. Thus, for the last two years Infantry recruits have been able to enlist for either three or seven years' colour service at their option. Owing to the continuance of active operations all three-years' men have been retained with the colours instead of being passed to the Reserve on termination of their period of enlistment. It has not been possible, therefore, to obtain any reliable statistics to show the proportion of these men who would, under normal conditions, extend their service. From the returns obtained on the 1st January last, there were serving in the Infantry of the Line 7,333 men who originally enlisted for three years' colour service. Of these only 399 had extended their service. It is possible that, owing to the units being on active service, these figures are somewhat inaccurate.

Several experiments were tried during the year to popularise the Army—a military tournament was held at Manchester, the Recruitograph, which by a series of photographs showed the various phases of a soldier's life and career, was exhibited in

various towns in Staffordshire and Worcestershire, and specially attractive pictorial posters were issued. By these and other means it is hoped that a certain amount of good has been done to the recruiting.

To meet the war requirements of the last two years, various expedients have been adopted—some temporary, others intended to be permanent. The report adds :—

"All such measures require most careful consideration, otherwise those adopted may serve merely, so to speak, to cause the recruiting market to compete against itself. The injury done to recruiting for Infantry of the Line by the large increases made to the more showy arms has already been pointed out. Offers were made to time-expired men in South Africa to extend their service on payment of a bounty of £5. The scheme failed entirely. The reason ascribed was that the men did not consider the bounty high enough, as compared with the large sums paid to men in the previous year to induce them to join the Royal Reserve Regiment for home service only. The terms of service for the Royal Garrison Regiment probably deter old soldiers from joining the Militia and from entering Section D of the Army Reserve. It may be also pointed out that simultaneously with a proposal to raise further drafts for the Imperial Yeomanry in South Africa attempts were made to raise Volunteer service companies to relieve those already on active service. This scheme was only partially successful, but it may be observed that out of the 16,431 Yeomanry recruits enlisted no less than 3,959 were Volunteers, who undoubtedly were attracted by the high rate of pay offered to the Yeomanry recruits, and thus preferred to join that corps instead of proceeding on service with their own companies.

"The terms of service of the new Reserve for the Militia require, therefore, careful consideration, otherwise the men joining it may merely be diverted from some other arm."

As to Distribution of Recruits, paragraph 43 of the report is as follows :—

The subjoined table shows the number of recruits enlisted during 1901 for the various arms of the Service, distinguishing those enlisted under ordinary conditions, those enlisted for one year or the duration of the war, ex-soldiers re-enlisted for a minimum service of four years at home or abroad, re-enlisted Imperial Yeomen, and ex-soldiers who joined the Royal Garrison Regiment :—

Arms of the Service.	Ordinary Recruits.	Recruits Enlisted for 1 Year's Service or the Duration of the War.	Imperial Yeomen re-enlisted for 1 Year.	Ex-soldiers re-enlisted under A.O. 106 of 1900.	Ex-soldiers re-enlisted under A.O. 59 of 1901.	Total.
Household Cavalry	201	—	—	—	—	201
Cavalry of the Line	6,365	—	—	32	—	6,397
Imperial Yeomanry	—	16,597	655	—	—	17,252
Royal { Horse and Field ...	6,837	75	—	112	—	7,024
Artillery { Garrison	2,851	—	—	104	—	2,955
Royal Engineers	1,810	828	—	68	—	2,706
Foot Guards	2,298	—	—	9	—	2,307
Infantry of the Line	22,148	4,748	—	108	—	27,004
Royal Garrison Regiment ...	—	—	—	—	4,052	4,052
Colonial Corps...	1,882	—	—	—	—	1,882
Army Service Corps	1,103	—	—	12	—	1,115
Army Ordnance Corps ...	456	—	—	7	—	463
Royal Army Medical Corps ...	1,088	886	—	78	—	2,052
Army Pay Corps	—	—	—	2	—	2
Army Post Office Corps ...	—	239	—	—	—	239
Total	47,039	23,373	655	532	4,052	75,651

The subject of the physical training of recruits at depôts has received the personal attention of the Commander-in-Chief. It has been considered probable that many of the desertions which occur during the first few months of the recruit's service are attributable to the fact that the recruit becomes disheartened by the amount of work he is called on to perform. Detailed instructions have been issued with a view of obviating the possibility of recruits being overworked during the period of their service at the depôt, and it is hoped that these instructions will have a beneficial effect. From a recruiting point of view, the very serious number of rejections owing to defective teeth among recruits offering for enlistment, cannot be ignored. Among the class of men from which recruits are drawn the deterioration of teeth appears to be rapidly increasing. Towards the end of the year instructions were issued to medical officers that recruits who are found on medical examination to be wearing artificial teeth should not be rejected on that account alone. Medical officers were directed to satisfy themselves that the loss of teeth in the first instance was not due to constitutional taint. It is satisfactory to notice a marked improvement in the proportion of well-educated men who have presented themselves for enlistment during the past year, the proportion being more than double that of 1897.

Militia and Militia Reserve.—During the year fourteen Militia battalions were recalled from South Africa or the Mediterranen, being relieved by other units which had volunteered for service abroad. These fourteen battalions were disembodied on arrival home.

At the commencement of the financial year, a most important change was made in the organisation of the Militia; the Militia Reserve and the Special Service Section of the Militia being abolished. No further enlistments for these two sections were to be allowed in future, though men already belonging thereto were allowed to finish their engagements therein. In place of the two sections above mentioned, it was proposed to create a Reserve for the Militia. The terms of service and conditions of enlistment in this new Reserve were referred to a Committee, which has since reported. Up to the present, the formation of this Reserve has not been proceeded with. By the terms of the Army Order authorising the formation of the Royal Garrison Regiment, men who join this latter corps are eligible for the new Reserve under certain conditions. For the purpose of home defence, it was decided to form a Brigade Division of Militia Field Artillery. The county of Lancaster was selected as the recruiting area to provide this new force. The new corps was formed partly by direct recruiting and partly by transfers from other Militia units to provide a nucleus of trained Militiamen.

Recruiting for the Militia shows a slight falling off, the number of recruits enlisted being 37,644, as compared with 37,853 in 1900. The second half-year was the more productive in results. The net increase for the year in the effective strength of the Militia amounts to 10,104. This increase is partly caused by the circumstance that 3,537 Militia Reservists rejoined their Militia units for permanent service with the Regular Army, and partly owing to the net loss from desertion being only 2,187, as against 9,436 in the previous year.

Home Imperial Yeomanry—The value of the Home Yeomanry organisation had been brought prominently to notice in consequence of the war in South Africa for the purpose of home defence, and also as a recruiting organisation to provide mounted men for service abroad. In May last, in consideration of the services rendered by the force in South Africa, and to perpetuate its title, the designation of the Force at home was altered from Yeomanry Cavalry to the Imperial Yeomanry. The report proceeds:—

"Drastic alterations were made in the pay and allowances of the Force with a view both to its popularity and greater efficiency. The periods of training were also increased. A medical examination was laid down as necessary, and a physical standard has been fixed, and, as has already been stated, a test for eyesight insisted upon. In August last the status of the force was changed by Act of Parliament, and from the date of the passing of the Act the force was placed under conditions of service similar to those of the Militia. In consequence of this change a form of attestation in place of the old enrolment form became necessary. During the past year ten new units have been formed, and the establishment of existing units has been raised. A committee was appointed to consider the recruiting areas for the new units and the changes necessary in the recruiting areas of the already existing units. Another committee, consisting of Yeomanry commanding officers, was also appointed to consider other matters connected with the corps."

Civil Employment.—Part VI. of the report deals with the civil employment of discharged soldiers and Reservists, and gives details of the appointments provided by Government departments, the police, the railways, official employment registries, and voluntary employment societies :—

The total number of men who left the Army during 1901 with characters entitling them to registration for civil employment was 29,932, and the number of men for whom employment has been found as follows :—War Office Register (messengers, etc.), 207 ; regimental district registers, 3,082 ; National Association (London office only), 784 ; Pensioners' Employment Society, 978 ; Guards' Employment Society, 82 ; departments under the War Office, 2,366. To these may be added men who are known to have themselves obtained employment, 11,027 ; men whose situations were kept open for them, 7,985—giving a general total of 26,511.

In conclusion, the Inspector-General says :—

"Recruiting on the whole may be considered fairly satisfactory. It was hardly to be expected that the figures would reach the high totals of the preceding year, bearing in mind that the enthusiasm caused by the war had undoubtedly diminished to a certain extent. General officers on the whole are satisfied with the physique, education, and character of the recruits enlisted. The continued failure of recruiting for the Infantry of the Line is the one serious factor in the situation. The more liberal policy instituted since the commencement of the war in the grant of pensions to wounded men, to widows, and children, and the continued assistance afforded to deserving cases by private societies all over the United Kingdom cannot fail to exercise a favourable influence on recruiting in the future. The Soldiers' and Sailors' Families Association have notified that their arrangements have been completed for the reception into permanent homes of soldiers permanently disabled by active service from earning their livelihood. The permission now given to non-commissioned officers and men of good character to wear plain clothes when on furlough should also serve to popularise the Army. In order that the public at large may be made aware of the reasons for which men have been invalided, instructions have been issued to record on their discharge certificates the wounds and injuries received by them on active service. In view of the fact that it is the coming generation from which the recruits for the future must be drawn, certain proposals made by the Incorporated Association of Head-Masters with the view to encouragement of military drill in secondary schools have been the subject of serious consideration. The War Department has arranged that every facility shall be given to these schools to obtain suitable pensioners, or Reservist non-commissioned officers to teach the boys elementary drill under military supervision. Adjutants of

Volunteers have been instructed to carry out an annual inspection of the boys in each school, and at the end of each year general officers commanding will submit a short *précis* of the reports received from these officers. Towards the end of 1900 it was laid down for the first time as a matter of regulation that the war medals earned by deceased officers and men should be issued as a matter of right to their relatives. During the past year full instructions have been given to carry this decision into effect, and officers commanding regimental depôts, etc., have been ordered to distribute the medals of the deceased[1] as expeditiously as possible to their relatives after receipt. . . . . In conclusion, I would remark that while the grand total of recruits raised for the past year is not equal to the high number raised in 1900, in which year no less than 24,130 Royal Reservists were re-enlisted, the fact that 75,651 recruits have been raised through Army agencies shows that the work of the Recruiting Department has been very heavy in 1901. In addition to these numbers, attention is directed to the fact that 7,739 recruits for the South African Constabularly have been raised during the year, 4,571 of whom were raised by recruiters of the War Department, making a grand total of 80,222."

BELGIUM.—The Chamber of Representatives have just passed a new military law, which the Senate will shortly be called upon to ratify. The principal subjects dealt with in the new law are:—1. Length of service with the colours. 2. Recruiting for and improvement of the cadres. 3. The maintenance of the peace strength. 4. The increase of the war strength.

I.—Length of Service with the Colours.

(*Normal Period of Service.*)

A. Contingent.	Old Law.	New Law.
Infantry of the Line	28 months in the course of the first 36 months.[1]	20 months in the course of the first 24 months.[2]
Chasseurs à pied		28 months in the first 30.
Train		
Grenadiers	36 months in the course of the first 48 months.	20 months in the course of the first 24 months.[2]
Carabineers		
Foot Artillery		22 months in the course of the first 24 months.
Special Artillery Company		
Engineers		22 months in the first 34.
Administration Troops		24 months.
Cavalry & Horse Artillery	48 months.	36 in the first 39 months.
Field Artillery		28 in the first 30 months.
Average...	33½ months	23 months.

B. Voluntary Enlistments.	Old Law.	New Law.
Before 17 years of age	An average of 5½ years.	5 years.
„ 18 „ „		4 years.
After 18 „ „		3 years.

[1] Having to undergo, in addition, a month's manœuvres every fourth year.

[2] Having to undergo, in addition, a month's manœuvres every third year.

II.—Encouragement of Recruiting and Improvement of the Cadres.

In order to foster the inclination for voluntary enlistment in the first line, the emoluments for volunteers and re-engaged men will be raised. Hitherto, only the recruits of the volunteers for the yearly contingent concerned had a claim to the allowance of 30 francs a month. In future, the following rates will be given to men of the normal regular service, viz. :—

	Francs.
To infantry of the contingent	25
To mounted troops of the contingent	30
To volunteers for the yearly contingent	30
To "volontaires de carrière"	35

To every re-engaged man, whether of the contingent or a volunteer, to substitutes, professional soldiers, etc., the following rates of monthly pay will be given : to privates, 35 francs ; to lance-corporals and corporals, 40 francs ; and to other non-commissioned officers, 50 francs.

It is attempted to induce voluntary enlistment into the second line by :—

1. The recognition of the preferential right to civil employment (*a*) for all non-commissioned officers after 8 years' service ; (*b*) for all volunteers and former volunteers.
2. Granting a pension for life to such non-commissioned officers who have not obtained any civil employment, when they have at least 20 years' service and are 40 years of age.

III.—The Maintenance of the Peace Strength.

The following table shows the former and the future peace effective of the Army.

Former.	—	Future.	—
Recruits, Volunteers with Bounty, Volunteers of Contingent, and Substitutes...	33,669	Recruits, Volunteers with Bounty, Volunteers of Contingent, and Substitutes...	24,500
"*Volontaires de carrière*"[1]	7,829	"*Volontaires de carrière*"[2]	14,100
Voluntary Recruits	1,000	Other engaged Men ...	2,000
Soldiers' Children (Cadets)	400	Soldiers' Children (Cadets)	400
		Civilian Artificers	1,800
Total	42,898	Total...	42,800

[1] 4,592 with normal period of service.
3,237 with more than normal period of service.

[2] 7,200 with normal period of service.
6,900 re-engaged men.

IV.—Increase of the War Strength.

In order to ensure this, the following is in contemplation :—

1. The granting of emoluments to "*Volontaires de carrière*," in order to increase their number.
2. Raising the period of service for the recruits from 8 to 13 years, 5 of which will be passed in the Reserve.

Hitherto the 8 years' period of service has obtained, which might be extended for 2 more years by the Government. For more than 10 years the King was able yearly to renew, and with great difficulty to extend, the period of service.

3. Doing away with the regulation by which married men and widowers with children were exempted from service.
4. Obligation for all "*Volontaires de carrière*" who are 18 years of age to serve for 13 years in the Army.
5. Organisation of a Volunteer Reserve; viz.: those who on discharge would be posted to the Reserve, will be compelled to serve 2 or 4 years longer in it.—*Précis from Militär-Wochenblatt.*

FRANCE.—The revised Estimates for the 1902 War Budget exceed the first Estimates by 2,578,722 francs, as the following comparison shows :—

1st Estimate :—

	Francs.
1st Section—Home Troops	641,248,850
2nd Section—Colonial Troops	26,329,000
3rd Section—Extraordinary Expenditure	49,122,150
Total	716,700,000

Revised Estimate :—

1st Section—Home Troops	643,654,469
2nd Section—Colonial Troops	27,824,603
3rd Section—Extraordinary Expenditure	47,799,650
Total	719,278,722

It is interesting to note that the present Budget exceeds that of 1892 by about 100,000,000 francs. The following items are accountable for increases in the present Estimates, viz. :—1. An excess of expenditure of more than 7,000,000 francs on the forage item, owing to the rise in the price of corn. 2. 2,000,000 more for the operations in Southern Algeria. 3. The formation of a special section of the general staff in the War Department. 4. Higher rates of pensions, for which 637,000,000 are required. Decrease of expenditure occurs through :—1. Not filling up vacancies amongst Engineer officers. 2. A decrease in the credit for re-engaged non-commissioned officers. 3. Withdrawal of the monthly wages for workmen not in the Service. 4. The gradual carrying out of certain regulations, viz., those regarding the veterinary *personnel* and the decrease in courts-martial. 5. Reduction in the reserve provision supply in corps districts to 1½ days' supply. 6. Reduction in the numbers of disabled soldiers and in the *personnel* of hospitals for them. 7. Saving by doing away with generals' inspections, etc. 8. Saving in the items powder and saltpetre. 9. A few economies in clothing and barrack accommodation, etc.

The report is divided into a short general introduction and into two parts. Part I. deals with the most important questions under five headings, viz. :—1. *Personnel.* 2. Administration, *matériel*, and establishments. 3. Organisation, command, and instruction. 4. Provision of military regulations, laws, etc., and recruiting reforms (in which the reporter advocates the two years' as against one year period of service). 5. Examination of the effectives serving as a basis for the scheme of the 1902 Budget.

Part II. of the Report deals with the sixty-two chapters of the Budget as well as with the three sections, viz. :—Home and Colonial Troops, and Extraordinary Expendi-

ture. The following innovations may be regarded as certain :— Reform of the service of the general staff, especially as regards the position of the chief of the general staff in war ; abolition of artillery schools in army corps districts ; separation of artillery and engineer officers as regards special training ; and raising the annual pay of lieutenants of 7 years' service from 2,616 to 3,000 francs.

M. Berleaux, the reporter to the French War Budget, has thought it of interest, as did his predecessor in 1897, to place before the Budget Commission documents showing the comparison between the military situations of the French and German Armies. On his demand, therefore, the War Department furnished him with five tables and a note, which it may be as well to examine :—

Table A.—Effectives (exclusive of Police).

——	France.	Germany.
Officers	23,222	25,199
Surgeons	1,349	2,190
Functionaries and Employés	3,829	4,997
Totals	28,400	32,386
Infantry	327,053	373,971
Cavalry	60,501	66,150
Field Artillery	51,543	64,529
Foot Artillery	13,226	22,666
Engineers	11,776	21,368
Administration, Schools, etc.	9,170	8,168
Transport	18,790	12,847
Totals	492,059	569,699

Making a difference of 77,640 to the bad for France. The above are nett effectives, viz., deduction having been made for those on leave, furlough, etc. It must be noted that in Germany the deduction is 3·2 per cent., whilst in France it varies from 7 to 8 per cent.

Table B.—Comparative State of Units.[1]

——	France.	Germany.
Infantry	2,880	2,505
Cavalry	454	481
Artillery	633[2]	740
Engineers	102	145
Transport	72	81

[1] Administration troops are not included in this comparison.

[2] Ten companies of which are workmen and artificers.

Then follow two notes on the organisation of the artillery command in the two countries, which are as follows :—

FRANCE.

The Artillery consists of :—

18 regiment of foot artillery.
40 regiments, making up 20 brigades of 2 regiments each.
14 mountain batteries.
A certain number of field and foot batteries in Algiers and Tunis.
10 companies of artillery workmen.
3 companies of artificers.
Artillery establishments (schools, etc.).

Foot Artillery Battalions.—The number of batteries to each battalion is variable and fixed by decree. As a general rule, these battalions are commanded by majors. When, however, a battalion consists of more than 6 batteries, it may be commanded by a lieut.-colonel, assisted by a major. Battalions allotted to the defence of a place are under the orders of the general officer commanding the defence. Other battalions are placed under the orders of the general commanding the artillery of the army corps.

Artillery of Army Corps.—Each army corps includes an artillery brigade, commanded by a brigadier-general, and consists of a brigade staff and of 2 regiments. One of the 2 regiments of the brigade is called the corps regiment, and is commanded by a colonel, the other regiment is called the divisional regiment, and is composed, as a rule, of the divisional artillery attached to each of the two army corps divisions. The artillery of the 1st Division is commanded by the colonel, and that of the 2nd Division by the lieut.-colonel of the divisional regiment. The divisional artillery is under the immediate orders of the general officers commanding the infantry divisions. Similar to those of foot artillery battalions, the number of the batteries of the different regiments is variable and fixed by decree.

Artillery with Cavalry Divisions.—A brigade division of 2 horse artillery batteries, commanded by a major, who is under the direct orders of the general commanding the division, is attached to each independent cavalry division.

Mountain batteries are divided into 2 groups, one for the XIVth and the other for the XVth Army Corps. Each of these groups is commanded by a lieut.-colonel under the direct orders of the general commanding the artillery of the army corps. The batteries are attached for administrative purposes to the divisional regiment of the district where they are stationed.

African batteries are formed into detached groups which are attached for administrative purposes to the regiments of the 19th Brigade. As regards command, the groups quartered in Algeria are under the immediate orders of the general commanding the artillery in Algeria.

GERMANY.

Field artillery is regulated by the Cabinet order of 16th June, 1899. "Field artillery is placed under the orders of generals commanding army corps and divisions as regards discipline, etc. These general officers are responsible to the State for the war preparation of the field artillery, as they are already for that of the infantry and cavalry." The 24 batteries which are included in each normal army corps are similarly distributed between the two infantry divisions of the army corps. Each of these divisions has an artillery brigade of 2 regiments of 3 batteries each (not including the horse artillery batteries for the cavalry divisions which are, in excess, attached to certain regiments). There is no longer any corps artillery. "Generals commanding army corps and divisions inspect the field artillery troops during manœuvres, during gunnery practice, as well as during the regimental drills. As a rule, inspections by generals of

division should take place at the same time as those carried out by general officers commanding army corps." The Inspector-General of Field Artillery is responsible for the technical supervision of the arm and for uniformity of instruction throughout the entire Army. His duties may be thus summarised :—The Inspector-General of Field Artillery supervises the gunnery instruction of the regiments ; he is responsible for the proper interpretation of, and for the carrying out of, the regulations of that branch of the Service ; he endeavours to perfect the *matériel* and to develop the technical knowledge of officers by a rigid supervision of the school and special establishments of the arm. He is the director of the Field Artillery School of Gunnery. Should he consider changes necessary in the regulations in force, he notifies the fact to the War Minister. He assists every year at the inspections on the practice grounds of as many regiments as possible. He is present at the Imperial manœuvres. Should he think it necessary to see the artillery of certain army corps carrying out other manœuvres, he refers the matter to the Minister of War. He corresponds with regiments through the army corps commanders. He addresses to army corps commanders a summary report on observations he has made in the course of his inspections, and offers his advice and suggestions with regard to anything he may have remarked in the various branches of the Service which are not directly under his authority. He adds his personal reports on officers, especially on the most senior ones. At the end of his annual inspections he sends a report of the whole to the Emperor and to the War Minister, and forwards extracts from this report to commanders of army corps, who communicate them to the troops concerned. He is under the immediate authority of the Emperor.

Foot Artillery.—These troops are not under the army corps commanders except as regards general discipline. As regards all else, they are immediately under the Inspector-General of Foot Artillery. This official exercises his authority through two subordinate Inspectors of Foot Artillery, the troops being grouped into 4 brigades, with a Foot Artillery Gunnery School, a chief artificers' school, and a commission for artillery experiments. He has the chief supervision of this branch of the Service. both as regards *personnel* and *matériel*. He is responsible for the armament of fortifications. He is under the immediate authority of the Emperor.

Table C gives a comparison in the increase of units in France and Germany, between 1872 and 1902. France was always superior in infantry, except in 1897. As regards cavalry, Germany was always ahead. In artillery, France had 30 batteries more than Germany in 1872, at present, she has 120 less. The same numerical inferiority obtains for the engineers and transport.

Table D shows an increase in effective during the same period of 30 years. In 1872, France had 399,221, and Germany 394,378 men. In 1902, France has 520,459 men (including officers), or an increase of 121,238 men. Germany, at the present time, has an army of 620,918 men, thus showing that the Army has increased by 220,540 soldiers.

The report contains a comparison of the German and French War Budgets of 1901-1902. The German Budget amounted to 698,529,009 francs, and the French Budget to 561,909,152 francs, the difference in excess for Germany being 136,619,857 francs.

Finally, Table E compares in detail the budgets of the two nations, *personnel* and *matériel* by arms and services, the figures of which are suggestive. For a superior effective to France of 77,000 men, Germany spends 100,000,000 francs on subsistence, whilst France spends 150,000,000. On the other hand, Germany devotes 100,000,000 francs to artillery and engineer establishments, whilst France only spends 5,000,000 on the same objects. The French *personnel* necessitates an expediture of 294,000,000, and

the *matériel* of 268,000,000 francs ; in Germany, the expenditure on *personnel* amounts to 380,000,000, and on *matériel* to 318,000,000 francs.—*Précis from Rapport du Budget Général de l'Exercice 1902, Jahrbücher für die deutsche Armee und Marine*, and *La France Militaire*.

GERMANY.—Last year was a particularly important one for Germany, because the reforms, laid down in the law of the 25th March, 1899, were almost completed on the 1st October last ; as a matter of fact the formation of the squadron of mounted orderlies in Saxony is the only item not yet carried out, and this will be done during the present year. In addition to the formations provided for by that law, that of 5 groups of machine guns should be noted, which came into existence on the 1st October, 1901, one of which is attached to the Guard Corps, and the other four, numbered from 1 to 4, to the four Jäger infantry battalions. The Germans are so satisfied with the services rendered by these five machine-gun groups that they have decided to give one to each army corps, and the 1902 budget provides for the formation of these new groups. Each machine-gun group of 6 guns consists of 3 officers, 67 non-commissioned officers and men, and 14 horses. The Germans are still carrying out experiments on the use of machine guns, and in addition to the 5 groups mentioned, there are a certain number of experimental groups. Germany has also completed the change in her field artillery *matériel* and the modified rifle is already issued to several army corps. The country has also made great pecuniary sacrifices in order to provide her siege and position artillery with new guns. She has also expended large sums of money on the improvement of old and on the construction of new fortified works. The 1902 budget also provides for the increase in foot artillery as well as for the building of other fortified positions on the frontiers. By the 1st October last there were formed 5 squadrons of mounted orderlies, a new regiment of foot artillery (No. 13), a new pioneer battalion (No. 21), which is attached to the XVIIIth Army Corps, whilst the 10th Battalion is transferred to the XIth, a second company for the ballooning group, and a third company for the 25th Pioneer Battalion, which has been numbered 18.

On the 1st April, 1901, to go back, there were formed a new local staff for the camp of instruction at Neuhammer, an experimental section for the communication troops, a new recruiting office, a scientific professorship at the Kaiser Wilhelm Academy, a non-commissioned officers' school at Treplow, 3 supplementary artillery depôts, a new railway commission at Bromberg, 2 new sanatoria, organised respectively in the IVth and VIIth Army Corps. These various formations have necessarily carried with them an increase in the officers' effective. It is also from the 1st April that the effectives of cavalry regiments have been regulated as follows :—10 regiments at the higher effective, 62 at the lower effective. In consequence, these regiments at the higher and medium effective have been diminished by 6, whilst those of the lower effective have been increased by 9. In addition, the effective of the horses of each squadron of mounted orderlies has been laid down at 132.

On the 1st October, Bavaria had carried out the Army reforms laid down by the law of the 25th March, 1899, and she now possesses 3 army corps, with their headquarters respectively at Munich, Würzburg, and Nüremberg, and having 6 field artillery brigades of 2 regiments each. These latter, with the exception of the 5th, which has, in addition, 2 horse artillery batteries, have only 5 batteries each. The Bavarian Army also includes 3 pioneer battalions, 3 transport battalions (the 3rd only having 2, whilst the others have 3 companies), 2 squadrons of mounted orderlies, 1 railway battalion, 1 balloon section, 2 foot artillery regiments of 3 battalions each.

As regards Saxony, to complete the provisions of the law of the 25th March, 1899, there only remains a squadron of mounted orderlies to be formed. She now has, at the present time, 4 normal field artillery brigades, each consisting of 2 regiments of 6 batteries each. Her 12th Artillery Regiment possesses, in addition, 2 horse artillery batteries, and each army corps has a brigade division of light field howitzers of 3 batteries. She has also raised a new infantry battalion, viz., the 625th of the German Army.

Note should be taken of the new dispositions of the 1st Army Corps, made with a view to cover the Russo-German frontier in eastern Prussia; facing the east, the 2nd Division is in the front line, with the 37th and 1st Divisions in échelon behind the flanks, and facing the south the 37th Division is in the front line with the 1st and 2nd Divisions in échelon behind the flanks. In consequence of the insufficiency in the number of sub-lieutenants, a certain number of quarter-masters, in excess of establishment, have been appointed to carry out the duties of these officers. Mention should also be made of the measure by means of which infantry sub-lieutenants (and exceptionally those of other branches of the Service) are attached for duty to the railway troops, and *vice versâ*; the courses organised at Field Artillery School of Gunnery for infantry and cavalry general officers, and at the Infantry School of Musketry for generals of cavalry and of field artillery.

The Germans have also gone in extensively for facilitating the concentration and the strategic deployment of their armies on the western and eastern frontiers. At the present time 16 railways communicate with the western and 11 with the eastern frontier. In this regard it may be said that, according to the information of the Russian press, the German Staff calculates on being able to mobilise their field troops in from two to six days, and the necessary train transport from the sixth to the fifteenth day of mobilisation. With Germany, as with other Powers, great difficulty is beginning to be experienced in recruiting the necessary number of re-engaged non-commissioned officers. Thus, during the past year, the German press notified a deficit of nearly 3,000 re-engaged non-commissioned officers. The military authorities, in consequence, took steps to retain with the colours a larger number of these men, and undertake to provide them with civil employment on completion of their 12 years' service. According to the latest information on this subject given by the German press, there will now be an excess of some hundreds of these re-engaged non-commissioned officers. As a matter of fact, however, this excess is only due to the disbanding of the greater portion of the China Expeditionary Corps (about 4,000), the re-engaged non-commissioned officers of which have been drafted to various corps of the home army. The deficit, of which mention has been made, is, however, certain to occur again very shortly unless the present industrial crisis from which Germany is at present suffering is prolonged, and in that case workmen might be induced to remain with the colours as re-engaged non-commissioned officers, owing to the poorness of the wages they would receive if they returned to civil life.

During the Imperial Manœuvres of 1901 experiments were made with regard to the endurance of the troops, particularly in the 1st Army Corps, during 17th September, and an attempt was made to give greater independence to cavalry divisions by providing them, through the attachment of machine-gun groups, with a new element of strength, viz., infantry fire. During the same manœuvres disembarkation exercises were carried out, and automobiles and optical telegraphy were further experimented with. In addition to the regular Grand Manœuvres, cavalry divisions executed special manœuvres, each with two horse artillery batteries and pioneer detachments

mounted on bicycles. On their part, too, the pioneers carried out special manœuvres, notably between the Elbe and the Saale. Mention should also be made of the manœuvres round the fortress of Bozen, in which troops of the three arms, with a strong proportion of foot artillery, took part. It is, no doubt, owing to the result of these manœuvres that the addition to the 1902 Budget of 2 new foot artillery companies for the fortress of Bozen is due. In addition to the above, the following also took place, viz.: Attack manœuvres on fortified field positions by the IInd Army Corps with live, and by the IIIrd Army Corps with blank cartridges; and the manœuvres of the Würtemberg Army Corps, in which a battalion of heavy field howitzers took part. The number of reservemen called to the colours was 174,724. On this subject it may be mentioned that the Budget for 1902 provides large sums of money to increase the drill period for reservists.

Amongst the new regulations published in 1901, are the following:—Cavalry Musketry Regulations; Balloon Drill Regulations; Foot Artillery Drill Regulations; the new edition of the Clothing Regulations, 1st part; New Instructions on the Rationing of Troops in the Field; Cavalry Telegraph Regulations; the New Instructions Regarding the Equipment of Batteries and Heavy Artillery Ammunition Columns. During the past year, courts of honour for Army doctors were established under the same conditions of those already existing for other officers; a law was passed on pensions to be given to invalids from war and to orphans; and also one on accidents experienced by military workmen and employés; instructions were also issued on the subject of aid to be given to families of soldiers belonging to the China Expeditionary Corps.

This brief account of the German military year cannot close without a few words on the German Chinese Expeditionary Corps, which has been disbanded, with the exception of a brigade of occupation maintained in the Far East. It should be recognised that although possessing no Colonial Army, besides being unaccustomed to such expeditions, Germany was able, in a comparatively short time, to organise and equip her Expeditionary Corps for China. In six weeks this force, consisting in round numbers of 30,000 men, and taking with it guns, wagons, and 30,000 cubic metres of provisions of war, was conveyed to the Far East in eighteen transports. At the same time, although the German press makes a great deal of the *rôle* played by their troops in China, it must be admitted that the German Corps arrived on the theatre of war when the most important operations were over.

At the beginning of the present century the German Army consisted of 625 infantry battalions, 481 squadrons, 583 field batteries, 38 foot artillery, 26 pioneer, and 23 transport battalions, with a total strength of 580,451 non-commissioned officers and men, and 125,000 horses. It will thus be seen that this real effective is even stronger than the budgetary one of 576,142 laid down by the law of 25th March, 1899, and which should be maintained until 31st March, 1904. As regards the reserve effectives, not including the Landsturm, it amounts to 2,685,000 men. Germany can thus put into the field on mobilisation, in round numbers, a field force of 3,250,000 men.—*Précis from Revue du Cercle Militaire.*

ITALY.—The Budget Estimates for the financial year 1902-1903 provide the War Minister with a credit of 275,000,000 lire. If this sum really shows the budgetary expenditure, it, nevertheless, gives no indication of the exact sum that Italy would expend on home defence. Thus a sum of 29,482,000 lire is added to the war budget for the Royal Carabiniers and for various other accessory expenditure which have nothing to do with the maintenance of the Army proper. If expenses foreign to the

maintenance of the Army, about 30,362,200 lire, is deducted from the round sum of 275,000,000,000 lire, it results that Italy actually spends 244,637,800 lire on her Army and on her organisation for home defence. This sum represents about 14 per cent. of the State general expenditure. During the course of the financial year 1902-1903, Italy proposes to keep up an average effective of 213,211 men, including Carabiniers, and 13,040 officers. If the carabiniers are deducted from these numbers, viz., about 654 officers and 24,470 men, it will be found that the average strength of the permanent Army is reduced to 188,741 men and 12,396 officers. The number of horses per arm provided for by the Budget is fixed as follows:—Infantry, 1,135; cavalry, 21,756; artillery, 12,229; engineers, 500; military schools, 715. Total for the permanent Army, 36,395 horses. The Royal Carabiniers, 3,771, making the grand total of 40,166 horses; of these 8,898 horses are allotted to officers.

The Extraordinary Budget provides for an expenditure of 16,923,000 lire thus distributed:—

	Lire.
Small Arms	2,000,000
Mobilisation Supplies	300,000
Coast Defence and *Matériel* for Armament	1,925,000
Defence of Alps	550,000
Defence of Rome	50,000
Armament and Fortifications	997,000
Military Establishments	850,000
Road Works	125,000
Field Artillery...	10,000,000
Purchase of Horses for Artillery	126,000

The sum of 100,000,000 lire for the construction of new Q.F. artillery *matériel* brings the amount up to 27,900,000 lire devoted to that transformation up to date. For the remaining four years, from 1903 to 1907, there remains a sum of 32,600,000 lire to be expended for that purpose. One of the consequences of this change in field artillery *matériel* is an expenditure of 126,000 lire to provide six instead of four horses per gun, the latter being the number used in the old equipment. The number of horses for field artillery regiments has, therefore, been increased by 192. If to the 244,637,800 lire that Italy expends on her Army is added the 111,396,379 lire she devotes to her Navy, a total of 356,034,179 lire is obtained for the purposes of her home defence. This sum represents nearly 21 per cent. of the State's general expenditure.—*La France Militaire.*

RUSSIA.—The Russian journals have devoted many articles to a review of the chief events of the year 1901. The *Ruskii Invalid*, in particular, has published an analysis of the principal measures taken by the War Minister in the course of last year, of which the following is a *résumé*:—

Hitherto Russian officers have entered the Army from two sorts of schools, viz., the Military and the Junker Schools. These schools differ very greatly from one another as regards both the general and professional instruction they impart. Officers coming from the Military Schools are greatly superior in all respects to their comrades from the Junker Schools. It is with the object of remedying this inequality between cadets of these two kinds of schools that the programme of study at the Junker establishments has been changed, and the standard for general instruction for Junkers has, therefore, been raised, and their professional instruction has been placed on an equality with that received by cadets at the Military Schools. Instead of two, cadets

will pass three years at the Junker Schools. Consequently, cadets from these schools, who formerly joined their regiments with only the rank of non-commissioned officer, and who had sometimes to wait a long time before being given commissioned rank, now enjoy advantages more nearly approaching those given to cadets from the Military Schools. Junkers, classified at the termination of their course in the first or second lists, are promoted at once to the rank of sub-lieutenant, those obtaining first places being antedated one year ; those classified on the third list are sent to their regiments as non-commissioned officers, but may be appointed sub-lieutenants after a year's service. (See JOURNAL for August, 1901.)

The conditions under which officers may contract marriages have been entirely changed. In future no officer will be allowed to marry who is not, at least, 23 years old, and has two years' service. In addition, officers whose annual pay amounts to less than 1,200 roubles (about £128) must prove themselves to be in possession of a private income of 300 roubles. Officers commanding corps give or withhold permission to marry ; in the former event they forward the application of the officer concerned to the general officer commanding the division, who gives definite permission. (See JOURNAL for May, 1901.)

In consideration of the increase of work imposed on officers in recent years, their right to leave of absence has been greatly augmented. (See JOURNAL for January, 1902.)

At the end of the past year, the Tsar approved of a scheme for increasing the pay of military doctors. Whilst awaiting the final settlement of this question the War Minister has received his Sovereign's orders to give every doctor a bonus of two months' pay. In order to raise the standard of the men's moral education, officers have been ordered to organise games, historical readings, and lectures, as well as theatrical representations, in the barracks.

By an Imperial order of the 9th May last, the cadres of the cavalry depôts have been re-organise l (see JOURNAL for September, 1901), and transformed into squadrons and regiments. This measure has placed the organisation of the cavalry reserve units in harmony with that of the active units. In consequence of the good results achieved by the machine guns during the campaign in China, an order has been given to raise, as a tentative measure, 5 machine gun companies, of which 4 will be attached to 4 infantry divisions of the Army of Russia in Europe, and 1 to the 3rd East Siberian Rifle Brigade quartered at Kwang-tung (see JOURNAL for May, 1901). In the 1st East Siberian Artillery Brigade, 2 mortar batteries have been converted into light batteries. The fortress artillery of Vladivostok has been reinforced by two new companies. In the Turkestan Military District, the 1st and 2nd Trans-Caspian Railway battalions have each been given a 6th Company. It may be remembered that in 1901 the Trans-Caspian territory was joined to the Turkestan Military District, whose troops now form two army corps (see JOURNAL for April, 1901). The fortified port at Kouchk, on the frontier of Afghanistan, has been declared a fourth-class fortress, and the Imperial standard was hoisted there last autumn, in the presence of the Minister of War, who, it will be remembered, was, at that time, making a tour of inspection in that district. It was also in 1901 that, in consequence of the new military organisation of Finland, 8 Finnish rifle battalions, as well as the regiment of Finland Dragoons, were disbanded (see JOURNAL for August, 1901). These special Finnish troops, which had a character entirely their own, and which differed in many respects from the Russian Army, have been replaced by 4 Finnish regiments of 2 battalions each, and the 55th Finland Dragoon Regiment. A new cadet corps has been formed at Vladicaucas, and 2 new preparatory military schools

have been organised in Asiatic Russia. Last autumn, the Nicholas Staff College was opened in large and handsome buildings, the construction of which was commenced in 1900. The Army Service Corps course, instituted in 1900, has been re-organised on a new basis ; it consists now of 2 classes instead of 1, which gives officers destined for that service, an opportunity of acquiring a more intimate knowledge of it.

The War Department has published the draft a new "Field Service Regulation and Battle Instructions for Detachments consisting of all Arms." This was edited by General Dragomiroff, and has replaced the former publications of 1881 and 1882. The technique and the tactics of the artillery have made rapid progress, those in authority have recognised the necessity of making commanders of other branches of the Service acquainted with artillery fire methods and *matériel*. With this object, since last year, infantry and cavalry generals, as well as corps commanders and heads of divisional staffs, are attached each year to gunery schools. In this year, too, the new Q.F. 76-mm. field gun was introduced into the Russian Army. The preparation for the mobilisation of the Army has also made great progress ; the commission appointed in 1899, to consider this important question has completed its work. The placing on a war footing of the reserve units of medium effective, as well as the requisitioning of horses, has been laid down to the smallest details.

The commission appointed to inquire into the means for diminishing correspondence in the Army continued its work during 1901. The commission proposes, with reference to this object, to extend the powers and privileges of subaltern officers. The government is also taking steps to lessen the military obligations of the Cossacks. With this object, as a tentative measure, for a period of five years, the Cossacks of the 3rd Levy both in European Russia and the Caucasus, will be dispensed from the annual camp assemblies. In addition, also as a tentative measure, for 5 years the Don Cossacks serving in the Guards' Cossack Regiments, as well as in independent sotnias and batteries, will receive a gratuity of 100 roubles for horse purchase. A medal has been struck for officers and men who took part in the China campaign, and in addition, the families of soldiers killed in that campaign have received financial assistance. In consequence of the suppression of the Boxer insurrection, the number of the units mobilised has been diminished, and the great number of the troops detached from European Russia to the Far East, have returned to their garrisons. According to the *Russki Invalid*, the following troops are still kept in China, viz. : the 1st, 4th, and 5th East Siberian Rifle Brigades ; the units of the 2nd, 3rd, and 6th Rifle Brigades of the same district ; the batteries of the 1st and 2nd East Siberian Artillery Brigade ; those of the Oussouri Horse Artillery Brigade ; and finally the sotnias of the Oussouri and Amur Cossacks.

According to the *Noroé Vrémia*, Russia at the present time has at her disposal, not including the Opoltchénié, 1,070,000 Regular and 2,900,000 Reserve troops, and can therefore, in a few days, enter on a campaign with, in round numbers, 4,000,000 combatants.—*Précis from La France Militaire* and *Revue du Cercle Militaire*.

CORRESPONDENCE.

THE STAFF AND INTELLIGENCE DEPARTMENT.—ERRATUM.

To the Editor of the JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.

SIR,—In the February number appears the full text of the Special Address I had the privilege of delivering on my return from a second visit to the Field Force upon "The Situation in South Africa."

My attention has been called to a statement on page 185 with regard to the preparations for the war by the Intelligence Department, and that it may possibly convey an erroneous impression.

I quote Colonel Henderson, lately Director of Intelligence to the Field Force, and now engaged on the official history of the campaign, as regards the absence of a *plan de campagne*, and of information regarding the country. That opinion was, I learnt on good authority, based on misconception. I, therefore, modified the passage in question in my speech and in the final proof. But, by mischance, an imperfectly corrected proof passed into the JOURNAL.

While I hold very strongly that the Great General Staff of the Army should be occupied entirely in preparing for any and every possible war, and have every detail in as complete readiness as had Count von Moltke in 1866 and 1870, I recognise that the Intelligence Department under Sir John Ardagh, and now under Sir William Nicholson, has done, and is doing, what it can with very limited resources.

I should be sorry, therefore, that any expression of mine in the theatre of the Institution or the JOURNAL should either give pain to any individual or do the slightest injustice to a department.

C. E. HOWARD VINCENT, Colonel.

27th February, 1902.

A REPLY TO MR. RUDYARD KIPLING'S "ISLANDERS."

To the Editor of the JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.

SIR,—As one who has for a great number of years devoted his time to the physical improvement of the Army, and through it indirectly to that of the nation, my attention has been directed to an attack on both of them by Mr. Rudyard Kipling—an attack, which, aided by his own genius, and the circulating capacity of the *Times*, may be said to have created a sensation. Nor is the fact to be wondered at. Mr. Kipling's genius has given the noblest expression to the pride and duty of the Empire. The Empire has been passing through a period of storm and stress. And when the most gifted advocate of its destinies turns round, and, instead of prophesying invincibility, proclaims decadence, so suddenly inspired a change of front is calculated to make the most sanguine stare. Nor has the matter ended in staring; 10,000 copies of some reply verses, run up on the spur of the moment, have been sold on a football field at 6d. a head, and Mr. Kipling has been threatened with burning in effigy by some of our most prominent Public Schools. As an admirer of his great natural gifts, I hope that so fiery an ordeal may be spared to him. But his poem of "The Islanders" has apparently

robbed these institutions of the belief that the battle of Waterloo was won on the playing fields of Eton, and though neither I, nor many thousands of others, share the poet's views, cricketers and football players are after all but men or boys, and athletes however hardy do not care to be labelled "flannelled fools" or "muddied oafs." In the course of some remarks I may be able to prove them neither one nor the other. I do not pose as a literary critic in any way, especially of Mr. Kipling's genius, which, when it runs in its usual course, I cordially admire. But if fact is often stranger than fiction, sound is sometimes taken for sense, and my experience in the study of the soldier's physical development gives me the opening to suggest that Mr. Kipling, irritated, not unnaturally, by that disproportionate prominence given to football and cricket matches while our Field Force is still engaged in South Africa, has let a too passionate Pegasus run away with him. Having briefly reviewed this Pegasus' erratic course, I propose to check its vagaries by the bridle of a few plain facts.

First, as to Mr. Kipling's indictment of the Army, and through it of the manhood of England at large. What his ablest advocate rightly calls his ringing and passionate verses contain ringing and passionate charges enough. Here are some of them taken at random: "Witless learning"; "The grudging of sons for the Service"; "Strong men cheering in millions while striplings go to the war"; "The training of horses and prize dogs"; "Flannelled fools at the wicket: muddied oafs at the goal"; "Men given to strong delusions"; "Idle except for boasting"; "Prepared to even the odds with nets and hoops and mallets";—a race destined, in the poet's vision, "to see the red glare to southward when its raided coast towns burn"; and, "to call the rabbit to war with its foemen" and, "the red-deer to horn them for hire." And all for what? Because in the poet's view the nation as a nation "can *neither ride nor shoot*"!

Now in this last charge it is evident that Mr. Kipling intends to drive home his whole indictment. Here we have a distinct accusation against the manhood of England as represented by the Field Force in South Africa. Poets, I know, are not to be judged by the rules of rigorous logic. I hope, however, that geographical conditions may claim their attention for a moment. Mr. Kipling may never have been at the wicket or at the goals; but he has been in South Africa, and he has seen a war waged there in an arena, and against an enemy, to which no parallel is offered by history. He lifts up his voice, in a heading, against 1,728 head of game falling on a Scotch moor to four guns; and sneers at shooting as a sport. But in South Africa he has seen a more lamentable result at the hands of what he may call "a little people, few, but apt in the field," but who in reality are nothing more or less than an army of mounted hunters, practising the craft he so much despises in a vast extent of country absolutely suited to that craft's needs. Does Mr. Kipling suppose that the Armageddon, which he prophesies so cheerfully, is to be waged on the veldt of South Africa? Or, in case of an invasion of this country, on the bare surfaces of Salisbury Plain? Does he suppose that the Boers have attained their proficiency in shooting by Sunday practising at village targets with ranges marked? Or that they have become practised horsemen by entering their veldt ponies at local race meetings? He knows very well that the Boers have become the marksmen they are from the practice of shooting game with a rifle in a widely rolling country, and of stalking it too. And that they have become the horsemen that they are from the necessity of remaining sometimes for long periods in the saddle, riding about large farms. Mr. Kipling is a war poet, but does he imagine that the storied experience gained from the "World's Wars" is to be put in the waste-paper basket, because a nation of armed hunters operating in an area made for

such practice, can leave their ponies behind a kopje, use such a natural fortress as a temporary ambuscade, and when they have made use of it, mount their horses and ride away over a perfectly open country to another? If it is only by such methods of warfare that the safety of England is to be assured, a few simple steps in a plain direction may be indicated. Our parks had better at once be laid waste; all hedgerows removed; large game imported; and every mother's son in the country given a rifle and a pony and told to earn his supper. Englishmen may then be the spectators of some different vision of war than that which assailed the imagination of Sydney Smith. We may not see acres of burning barley, because, I believe, we haven't many in the country. But we may hear the protests of travellers accidentally shot; see the parson's cow wounded by a stray Mauser bullet; and a parish councillor touched in the hinder part. It is indeed impossible to treat such a view seriously. Nor do I imagine that, in spite of his admiration for Boers and bushmen as practical soldiers, in defined conditions of veldt or bush, does Mr. Kipling seriously entertain it. He has apparently been impressed and led away, as have many others, by a series of events which could only have occurred under conditions quite unprecedented; and against the recurrence of which any expert would do a great deal more than "lustily *even* the odds," for any given space of time. Because an army of mounted hunters has proved an agile foe in an open country, are we to have nothing but soldiers who can ride? Is Napier's "astonishing infantry," whose descendants forced the lines of the Tugela (constructed by a foreign engineer officer, by the way) to be but a memory of the past? Are spurs to be the only wear? Are the vineyards under Spicheren forgotten, where in 1870 the French cuirassiers went to their fate? Or the hedged fields of Mars-la-Tour which decimated the German dragoon guards? Or the deep lane outside Sedan which engulfed whole squadrons of Chasseurs d'Afrique? Or still later the hunting country used in some recent Continental manœuvres, which brought a brilliant cavalry charge to a disjointed trot, long before it came under fire of the machine guns? I can, I think, leave Mr. Kipling's grave charges about riding, and leave (what he has left of the cavalry) to take charge of itself.

But neither can our soldiers shoot, it would seem. Have all the enemy's fallen then, been accounted for by our brave Australian allies, whose experience of bush life, of its long distances, of its natural hardships, has given them in some measure the advantages held by the pastoral dwellers on the veldt? Statistics confute such a surmise. But, for the sake of argument, taking such a fact to be granted, and taking the further fact to be granted that even such spaces as Salisbury Plain are limited, and that the parks of England cannot be turned into common land to enable patriots to become marksmen by shooting with rifles at running game—what other road to proficiency is left open, but rifle butts, and the strict training which enables aspirants to excel at them? And here for the first time I am in concord with Mr. Kipling—not in the matter which he would seem to conceive of having rifle butts all over the country, but in the matter of that *physical training and condition* which can alone make a patriot, however fervid, a good shot. With much of Mr. Kipling's recipe to this end I cordially agree. In the poet's own words, "men are to be soberly taken and trained for the same"; and he further mentions that success can only be achieved "after trial and labour, by temperance, living chaste — and the matter must be weighed and pondered and worshipped and practised day on day." But is not this a rule which has animated every man who has wished to excel in a physical and scientific exercise since the word was first coined? It is a maxim which has animated the military gymnasia of Great Britain for many years. In spite of his outpourings

against "flannelled fools" and "muddied oafs," it is not to be supposed, I imagine, that Mr. Kipling considers shooting a sedentary exercise, or one to be acquired by that snub-nosed rogue seated behind counter and till of whom Tennyson so martially and appropriately sang. Expert shooting, like expert cricket, football, boxing, and fencing, can only be attained by getting the bodily physique, comprising brain, eye, hand, and muscle, into the highest state of efficiency without overstrain. Our gallant enemies the Boers have had to do this through the common necessities of their daily life. So have our allies the Australian bushmen. Does Mr. Kipling so despair of our country's condition as to imagine that means to a similar end are not daily taken in our Army? I shall hope to disabuse him of such a superstition, if it lives by facts within my own knowledge.

The voices of panic being then for the moment stilled, let me tell Mr. Kipling and his fellow pessimists what has been done, and is being done day by day in the military gymnasia, aye, and outside their walls too—to make Englishmen worthy of their heritage, and to avert that last blotting out of the race which the author of "The Islanders" so luridly foretells.

It may then, in the first place, interest Mr. Kipling to learn that expert opinion suggests the habitual pursuit of wild animals in an open country as the sport which would give the best training to our soldiers. Even military authorities however are not omnipotent. And as we have neither wild boars in England, nor an open country to pursue them in, the advantage indicated has had to be left to the hunters of the African veldt. But the athlete broadly understood must always form the main foundation of the hunter—to whose craft, muscle, nerves, alertness in seizing opportunity, and steadiness of hand and eye, are absolute essentials. It has, therefore, been the object of the military authorities, since they cannot make their soldiers those hunters which poets wish, to take at least the first step in the direction, by making them physically fit. That is to say by a course of training, gradual, systematic and progressive, to bring about the development of the greatest dexterity in the individual man. Continental authorities hold, and rightly too, that by such a regulated course of physical training not only does the soldier gain an increased dexterity in the handling of his weapon, but also further most essential qualities of the hunter. For myself I will go further, and say this: Experiments, as an enterprising nation, are always with us. They may, however, at any time fail us at a critical moment. But physical training can never under any circumstances fail us; for the plain reason that the man with hard muscles and ample chest and lungs is certain to go further, longer, and more easily, and be more fit to fight on arrival at the fighting point than the man whose physical powers are undeveloped. The man who has undergone the real physical training now in vogue in the Army has not only had his various muscles strengthened and made elastic, but he has had his nervous power increased by the quickening and deepening of respiration; his intellect has been sharpened; his body trained to obey with readiness and precision the dictates of the mind. Have we not here the very primary essentials for the man who can ride and shoot?

In this connection, will it further surprise Mr. Kipling to learn that amongst the factors that are held by experts to best bring soldiers to this state of physical efficiency may be numbered those very games of cricket and football which so excite his scorn? Is he aware (so essential a factor in physical training are these games thought by the authorities) that each of His Majesty's ships of war, every regiment of cavalry and infantry, every battery of artillery, or company of engineers, has at least a football club, comprising, as a rule, the whole strength of the unit possessing them? As one who has sung about soldiers, has it come to his knowledge that the bulk of the officers

of Sir Herbert Stewart's force, in his march across the Bayuda desert, were all well-known sportsmen and athletes? And that it has been proved to demonstration that the fact of his men having engaged systematically in such sports contributed directly to the result of Lord Roberts's march to Kandahar? Why one regiment (the 92nd Highlanders) which took part in that march never lost a man from physical exhaustion, and always carried off over two-thirds of the total open competitions when any sports were held? And why? Not because they had stood with arms akimbo and pipes in their mouths while others were "flannelled" at the wicket or "muddied" at the goal; but for the simple reason that every company in that regiment had its athletic club, subscribed to by the men at 6d. a month. They had indeed followed Horace's recipe for athletes: had learnt to do and to suffer much; to sweat and to thirst; to leave sensual indulgence and drunkenness alone; and, in plain words, by doing these things habitually of their own free-will, and in the hours of exemption from military duty, they had acquired without doubt the best possible training for field exercises. Facts are stubborn things. And before such facts as these—and they could be multiplied—sonorous sneers composed on the spur of an irritable moment fall harmless. But before leaving the cricket and football which so excite Mr. Kipling's animus and muse, it may be well to remind him as a poet of Empire, that it is not wise in the training of an Army to ignore national characteristics. Nor because there may be some nations, which it would be invidious to name, who are incapable of understanding the pleasures of the defence of a wicket for hours under an August sun, or of standing shivering as a goal-keeper in a nort-east wind without ever letting watchfulness flag or a chance escape, does it seem to me wise to deride relaxations which actually sterilise and destroy the very propensities to vice. A man who is unsteady very soon loses his place in a football team. And a toper will not be seen at the top of the cricket averages.

But since our recruits cannot fit themselves for service by chasing wild game on ponies over an open country, what, it may be asked, are the authorities doing to make the manhood and the Army of England efficient for the field? Having learnt the valuable truth that sports and gymnastics re-act upon one another, they have been steadily, and for years, perfecting a system of physical education which gives scope to each of these educating forces without giving undue prominence to either. Sports and outdoor games are much encouraged; liberal expenditure is permitted on the part of officers commanding regiments and corps under the head of sports, games, etc., for the men out of the Canteen Fund; leave is freely given to those desirous of taking part in such sports (subject, of course, to service exigencies). The authorities also sanction public exhibitions of skill, holding amongst other tenets that, quite apart from cricket and football, boxing and fencing are admirable disciplinary modes of relaxation and exercise, especially from a military point of view; while, as for riding, or the lack of it, that we hear so much of—since cavalry officers have no vast veldt to go flat racing upon, and as it is within the bounds of possibility that the next big war may take place in an enclosed country, rendering some knowledge in the art of riding over fences necessary, they are expected almost as a *sine quâ non* (subject again, of course, to service exigencies) to hunt regularly throughout the winter months And this policy is actuated by the conviction that sport of all kinds contributes vitally to strengthen both mind and body, by fostering the mental alertness needed for them all, and by the constant re-action of mind on body which teaches a man physically to endure. And by the further experience also that soldiers in a field force, who have been thus hardened, do not by breaking down fill those hospitals which should only be occupied by the wounded.

With regard to the second division of physical training, apart from out-of-door sports, and which may be classed under the head of Gymnastics, *In medio tutissimus ibis* has been taken as a motto, and in a system which aims at producing as high a combination of strength and agility as is possible in an average man, the common mistake of overwork is rigidly avoided. Staleness is the inevitable result, occasioning an unnecessary loss of men, whom intelligent training would have changed from weak lads into strong and useful soldiers. The enormous importance attached to it by all Continental nations is well known. They define it (with that facility for definition which is theirs) as "the raising up of the general level of the whole mass." That the value put upon this side of a soldier's training is not an over-estimated one can be proved by the history of nations. The life of almost every one of them shows the following stages :—

1. Physical education universal (either through the struggle for existence or from previous prestige).
2. Physical education absent altogether (through the invariable tendency of luxury).
3. Ultimate conquest by a nation in Stage I.
4. If not too far over-run and absorbed, recurrence to Stage I.

It was in the zenith of the power of Greece that bodily education, and consequently bodily perfection, reached its highest point ; the Swiss, hardened by a constant struggle with nature, have never been conquered for long ; from the physical and moral discipline of Jena, Prussia rose to Königgrätz and Sedan. And those who wish to see the value the most practical nation in Europe puts upon physical education should go to Germany, and study in her gymnasia both military and civil ; for military gymnastics are not the only ones insisted upon among Continental nations — every civilian is subjected to a systematic and carefully regulated course. And it might be well for the future stability of our Empire, if our rising youth or their parents could be persuaded to see this advantage in its true light. Signs are not wanting that time and patience may achieve this result without people fearing that board schools are nurseries for conscription. As the affairs of nations are after all but the affairs of Tom, Dick, and Harry, so the capacity of Tom, Dick, and Harry for the struggle for existence depends in a large measure on their physical well-being. And this state of physical well-being is most surely induced by bodies being trained systematically at the very moment when they will respond most readily to the call. It may be objected that the physical training of youth at board and elementary schools should be confined to such games as can be played daily in the school grounds. But is there always room in such grounds? And even if there is space for every pupil to play at what pleases him, there will always remain a remnant of idlers who will not play at all. What physiques are likely to be the properties of these loafers? They will grow into men physically unfit for citizenship in any calling in life. It is indeed beginning to be the fixed opinion of many capable of judging that some such course of regular training as obtains in our military gymnasia is nothing short of an essential to the future of the race. The object may gradually be obtained without frightening susceptibilities. And with this end in view the following memorable words of von Schmidt may be borne in mind :— "It is not possible to carry far enough the development of the bodily activity of our men, not only that they should thereby become more dexterous in the handling of their weapons, more apt for the performance of their duties ; these are the direct material results. But they become accustomed to perseverance, venturesomeness, and enterprise. They learn to will—which is equivalent to being able." A weightier argument in

favour of the physical training of Englishmen, whether soldiers or civilians, could not well be put before Mr. Kipling, and he may observe that in it the art of shooting is thrown in, to say nothing of riding too. And this is a foreign recipe. An additional suggestion from one of his own "Islanders" directly tending to show the inestimable value of all physical training on a nation, whether freely enlisted or conscript—and the latter ghost really lurks behind the poet's innuendoes—may be adduced in the following extract from Professor Henry Drummond's Lowell Lecture on "The Ascent of Man." "So great indeed," he says, "is the advantage of increasing mechanical supplements to the physical frame, rather than exercising the physical frame itself, that this will become little short of a temptation. And not the least anxious task of future civilisation will be to prevent degeneration beyond a legitimate point, and keep up the body to its highest working level."

Not, however, so far as the national safety is concerned by riding and shooting only, as I have endeavoured to point out. South African experiences are valuable, but they will not wipe out a nation's military history, or the methods, gradually progressive and accumulating, by which that record has been won. The panic begotten of sudden experience is nearly always misleading. It often paves the way to disasters graver still. Rifles and riding are now the vogue; because a nation of born and mounted hunters have from infancy learnt to shoot running game from behind rocks scattered at advantageous points on a vast veldt. But to insist once more upon what I may term the exaggerated perspective of the idea as one that is likely to be a military experience of permanent value, let me raise my voice in favour of the bayonet. I am of the firm opinion that whatever other portion of the physical training of the infantry soldier may be neglected, the importance of his being taught the use of the bayonet in attack and defence should be especially insisted upon. It is of incalculable advantage to the soldier both for encouraging his spirit of combativeness, and for enabling him to render a good account of himself when attacked at close quarters. Even when an infantry regiment's ammunition is exhausted, there is still the bayonet left.

Statistics are dry reading, but they are useful reserves to call upon when one has not the gift of writing popular verse. Statistics in support of my contention that England, in spite of South African reverses, is not going to the dogs could be tabulated without number. Nobody, however, will deny Mr. Kipling his literary power, and his interrogatory admonitions to his compatriots have had their vogue. But I believe that I have put forward some facts which may tend to relieve his readers of the fear that their country is for ever undone. I have in the first place, I hope, established as a generally acknowledged fact that our reverses in the South African War were so largely owing to the local conditions under which the war was carried on—conditions which are hardly likely to occur again, as to reduce all possibility of drawing valuable inferences from them to a vanishing point. To Mr. Kipling's contention that our disasters have arisen, and will arise, from the fact that our men can neither shoot nor ride, I reply that at the present time of speaking the shooting of our Army is quite up to the Continental standard; that in any future Continental war, soldiers may be required to ride very little, if at all, aggressively; and that if riding be required of them, it will probably be over a country which would bring Mr. Kipling's "little people, few, but apt in the field" to a conviction of inaptitude in an amazingly short space of time. I have further shown that those powers of endurance and hardiness which, in Mr. Kipling's view, have made the Boers pre-eminent, are the direct results of the environment in which they have been compelled to live; and that those environments not being ours, a continuous and

successful effort has been made to obtain approximate results by a carefully calculated system of physical training.

That such a system of training has had its effect in field stricken, that it will have its effects in fields to be stricken yet, is as certain as the fact that it embraces in its wide scope those very games of football and cricket which move Mr. Kipling's muse to maledictions. Trained hunters may shoot as well as necessities may compel them to. They will always shoot better than people whose environments can never offer the same range or targets. But no superiority of Boer marksmanship will avail against the contention that much of that very superiority comes directly from a fine condition of normal physical well-being, and that every possible opportunity that circumstances permit is being given every day to our own soldiers to attain to a like state. Cricket, football, fencing, boxing, gymnastics, are sports embedded in the nation's character. Apart from purely military exercises, they have helped very much more than people know to make the English soldier what his enemies know him to be, that factor which makes Indians often exclaim on seeing the way in which our officers lead their troops, "This is the work of gods, not men." These are words which should bring pride to the hearts of Britons. Pride goes before a fall, as we have learnt in the columns of the *Times;* and this quotation of a perfectly familiar Indian comment on the bearing of our troops may renew Mr. Kipling's forebodings of disaster and fill him with a renewed sense of the unfitness of things civil and military. It is to be doubted, however, whether any condition of astonishment created in him will equal that with which practical men have read his attack on our forces at present in the field; and have noted, that in a national poet's prophecy of his country's impending invasion no mention is made of that Navy, not also, I trust, hopelessly effete, which must always remain England's first line of defence.

Yours truly,

G. M. Fox, Colonel,
Inspector of Gymnasia.

NAVAL AND MILITARY CALENDAR.

FEBRUARY, 1902.

1st	(Sat.)	4th Bn. Durham L.I. (Militia) 3nd Bn. Argyll and Sutherland Highlanders (Militia)	} Left England for South Africa on the "Canada."
3rd	(M.)	3rd Bn. King's Own Royal Lancaster Regiment (Militia) arrived at Southampton from South Africa on the "Tintagel Castle."	
4th	(T.)	H.M.S. "Goldfinch" commissioned at Sheerness for Surveying Service.	
,,	,,	H.M.S. "Irresistible" commissioned at Chatham for Mediterranean.	
,,	,,	H.M. Sloop "Espiègle" left Sheerness for China.	
5th	(W.)	Lord Kitchener reported that Colonel Byng captured De Wet's last pom-pom and killed 5, wounded 6, and captured 27 Boers.	
,,	,,	Lord Kitchener announced that Major Leader, without a casualty, killed 7 and captured 131 of Delarey's commando.	
,,	,,	It was officially announced that the Dinkas seized a camel convoy in the Bahr-el-Ghazal in January last, and killed the British officer in command.	

6th (Th.) By Lord Kitchener's careful dispositions the Boers under De Wet were driven from the Heilbron-Frankfort blockhouse line towards the Kroonstadt-Lindley blockhouse line. The Boer losses were heavy, being nearly 300 in killed, wounded, and prisoners. De Wet escaped. British losses slight, amounting to 10.

" " 2nd Bn. Royal Inniskilling Fusiliers arrived at Cape Town from India on the "Armenian."

7th (F.) Lord Kitchener announced the capture of Commandant Marais.

8th (Sat.) 26th (Veteran) Bn. Imperial Yeomanry left England for South Africa on the "Braemar Castle."

" " Colonel von Donop captured 2 laagers near Wolmaranstad with 36 prisoners.

" " 23 Boers surrendered at Middelburg.

10th (M.) 3rd Bn. Cheshire Regiment (Militia)
4th Bn. The King's (Liverpool Regiment) (Militia) } Arrived at Cape Town from England on the "Oratava."

" " 2nd Bn. Royal Dublin Fusiliers arrived at Aden from South Africa on the "Sicilia."

" " The Boers attacked a convoy near Fraserburg, Cape Colony, and were repulsed. British lost 13 killed, 48 wounded; and Boers lost 24 killed, 47 wounded.

" " A party of the S.A.C. were driven back with loss by the Boers at Waterval River.

11th (T.) H.M.S. "Diadem" paid off at Chatham.

" " H.M.S. "Iphigenia" arrived at Portsmouth with relieved crews from China.

" " Launch of H.I.M. training-ship "Ocean" from Germania Yard, Kiel, for Russian Navy.

" " Details published of a Treaty between Great Britain and Japan.

" " 2nd Bn. Royal West Kent Regiment left Aden for Malta on the "Sicilia.'

12th (W.) The Malta Mounted Infantry Battalion lost 11 killed and 40 wounded in an engagement with the Boers in Zuikerboschrand.

" " Victorian detachment of Australian Federal contingent left Melbourne for South Africa on the "St. Andrew."

13th (Th.) 6th Bn. Manchester Regiment (Militia) left England for South Africa on the "Dilwara."

15th (Sat.) Army Estimates published: Total £69,310,000, a decrease of £23,605,000.

16th (S.) A portion of General Elliott's force engaged a large party of Boers, under De Wet, at Tronmel, and captured a heliograph and 10 of the enemy.

17th (M.) 450 Canadian Mounted Rifles arrived at Durban from Halifax on the "Manhattan."

18th (T.) A party of the Scots Greys was cut off near Nigel, in the Heidelburg District: 2 men were killed, 2 officers and 6 men wounded, and 46 captured.

" " 4th Bn. Worcestershire Regiment left England for Bermuda on the "Harlech Castle."

19th (W.) H.M.S. "Philomel" arrived at Plymouth from Cape.

19th (W.) 4th Bn. Durham Light Infantry (Militia) } Arrived at Cape Town from England on the "Canada."
" " 3rd Bn. Argyll and Sutherland Highlanders (Militia) }

" " 1st Bn. Commonwealth contingent left Sydney for South Africa on the "Custodian."

" " 3rd Bn. Loyal North Lancashire Regiment (Militia) left Cape Town for England on the "Gaika."

" " The Boers, under Commandant Ross, rushed the Frankfort-Vrede blockhouse line with a herd of cattle, but suffered heavily.

20th (Th.) H.M.S. "Goldfinch" left Sheerness for Mediterranean.

21st (F.) H.M.S. "Amphitrite" arrived with relieved crews from China at Plymouth.

" " 2nd Bn. Royal West Kent Regiment arrived at Malta from Aden on the "Sicilia."

22nd (Sat.) Lord Kitchener reported that Colonel Park with mounted troops and National Scouts captured 164 prisoners near Bothasberg.

24th (M.) 5th Bn. Royal Dublin Fusiliers (Militia) arrived at Queenstown from South Africa on the "Pembroke Castle."

25th (T.) 3rd Bn. West Yorkshire Regiment (Militia) left Malta for England on the "Sicilia."

26th (W.) Lord Kitchener reported the capture by the Boers of an empty British convoy and 2 guns near Klerksdorp. British loss 118 wounded, 467 captured.

27th (Th.) After a great drive the Boers, under De Wet, were crushed against the Harrismith-Van Reenan blockhouse line, and 819 of the enemy were killed, wounded, or captured. Manie Botha was killed, and De Wet's son and Commandants Meyer and Trutter were captured. De Wet himself escaped. Enormous quantities of ammunition and cattle were captured by the British.

28th (F.) 26th (Veteran) Bn. Imperial Yeomanry arrived at Cape Town from England on the "Braemar Castle."

FOREIGN PERIODICALS.

NAVAL.

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AUSTRIA-HUNGARY.—*Mittheilungen aus dem Gebiete des Seewesens.* No. 3. Pola: February, 1902.—"A Study on the Equilibrium of Floating Bodies in General and Ships in Particular." "The Progress in the Development of Ships' Armour and in Naval Guns in 1900." "Foreign Naval Notes."

BRAZIL.—*Revista Maritima Brazilieria.* Rio de Janeiro: December, 1901; January, 1902.—Have not yet been received.

FRANCE.—*Revue Maritime.* Paris: February, 1902.—"An Inquiry into the Dynamic Laws of the Air in Cyclones." "The Question of Water-tube Boilers in the German Navy." "Types of Battle-ships and Cruisers." "Naval Episode in the Brazilian Revolution." "Spain and her Necessary Navy."

Le Yacht. Paris: 1st February, 1902.—"The Question of the Engineers." "Yachting Notes." "An Oceanographical Station near the Coast." "The Mercantile Marine, French and Foreign." 8th February.—"The Report on the Naval Estimates." "Yachting Notes." "The Veteran Seamen of the Five Naval Ports." 15th February.—"The Report on the Naval Estimates" (*continued*). "Yachting Notes." "The Swedish Mercantile Marine." "The Specialisation of Ships for Naval Transports." "The Mercantile Marine, French and Foreign." 22nd February.—"The Report on the Naval Estimates" (*continued*). "Yachting Notes." "The Japanese Battle-ship 'Mikasa.'"

Le Moniteur de la Flotte. Paris: 1st February, 1902.—"The Navy and the Crimean War." "One Useful Result of the Publication of the Estimates of the Naval Powers." 8th February.—"The Speed of Battle-ships." "Re-organisation of the Ministry of Marine." 15th February.—"The Speed of Battle-ships." "The Anglo-Japanese Alliance." "The Navy in Parliament." 22nd February.—"The French Naval Movement in 1901." "The Navy in Parliament." "The English Naval Estimates."

La Marine Française. Paris: 1st February, 1902.—"Some Documents which would be Useful in Writing a History of the Franco-German War: A Reminiscence of the Cruise of the German Corvette 'Augusta.'" "Report of Vice-Admiral De Beaumont on the Arsenal and Port of Toulon." "The Present State of the World's Submarine Cables Question." "The Boiler Accident on board the 'Runcorn.'" "Foreign Naval Notes." 15th February.—"The Dispute between the Executive and Engineer Officers." "Historical Development of the Naval Power of Great Britain, According to Russian Ideas." "The Mercantile Marine before Parliament." "The Demands of the Officers of the Administrative *Personnel* of the Navy." "Ships on Trial: 'Chateaurenault,' 'Jeanne d'Arc,' 'Jurien de la Gravière.'"

GERMANY.—*Marine-Rundschau.* Berlin: March, 1902.—"Privateers, and Maritime Law." "De Ruiter." "From the Old Time Brandenburg-Prussian-German Fleet to the time of Benjamin Raules (1675)." "The Instruction in Navigation in the German Navy." "The New Organisation of the French Ministry of Marine." "Seamen's and Soldiers' Homes at Kiel, Copenhagen, and Göteborg." "The British Statistics of Disasters at Sea, 1899-1900." "On the Prevention of the Malarial Epidemic in the New Dock and Harbour Buildings at Wilhemshaven." "Foreign Naval Notes."

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February, 1902.—"Some Brief Reflections on the Portuguese Navy." "Protection against Malarial Fever in Hot Climates." "Studies on Emigration" (*continued*). "Delimitation of Portuguese Guinea" (*continued*).

SPAIN.—*Revista General de Marina.* Madrid: March, 1902.—"The Indispensable Fleet." "The New Japanese Cruisers 'Niitaka' and 'Tsushima.'" "The Mails." "Administration and Control." "The 'Victor Emanuel': A Comparison Between Modern Battle-ships." "A Memorandum Relative to Destroyers, having Regard to the Loss of the 'Cobra.'" "Some Remarks on the Re-organisation of the Navy." "The Last International Congresses on Hygiene and Democracy." "The Theoretical and Practical Instruction of the Naval Officer." "The Galleys of Vigo." "The Portuguese Navy." "Naval Notes."

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Organ der Militär-wissenschaftlichen Vereine. Vienna: Vol. LXIV., Part 2.—"The Causes for and the Course of the Chinese Disturbances." "Armed Strength and the Press." "Medical Statistics of the Austro-Hungarian Army from 1894 to 1898."

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BELGIUM.—*Bulletin de la Presse et de la Bibliographie Militaires.* Brussels: 15th February, 1902.—"Wounding Effects of Small-bore Weapons—Experiences of the South African War." "Social Education in the Army" (*continued*). 28th February.—"Social Education in the Army" (*continued*). "Attack on Fortified Field Positions."

FRANCE.—*Revue du Cercle Militaire.* Paris: 1st February, 1902.—"Report on the War Budget for 1902." "A Russian Opinion of the French Army" (*concluded*). "Modern Alliances" (*continued*). 8th February.—"The German Military Year, 1901." "Recollections of Marshal Canrobert." "Report on the War Budget for 1902" (*concluded*). "Modern Alliances" (*concluded*). 17th February.—"Russian Army—Fête of the Emperor's Riflemen." "Central Administration of the Admiralty." "The

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Military Service for the Boers in German South-West Africa." 12th February.—"A Criticism by the *Gaudischen Journal*." "Cross Country Racing by Night." "Intelligence from the French Army." 15th February.—"Sighting of the New French Field Gun" (with 3 sketches). "The Boer War—Second Part" (*continued*). "New Instructions on the Further Training of Officers in the United States." 19th February.—"The Campaign of Magenta." "Carrier Pigeons." "The New Scheme for Ameliorating the Military Service of Cossacks." "Scheme for Mounting Field Artillery Officers entitled to Horses." 22nd February.—"French Heavy Artillery" (with 2 sketches) "Catalogue of Captured Chinese Banners." "Carrier Pigeons" (*concluded*). 26th February.—"The Passage of Rivers by Napoleon I" (with 4 sketches). "Is the Modern Jacketed Bullet too Humane?" "The Remounts in the South African War."

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SPAIN. — *Memorial de Ingenieros del Ejército.* Madrid: January, 1902.— "Frustrated Attack Against Brussels in 1708." "Verification of Ampère-Meters by the Electro-Chemical Method." "Siemens and Halske Telegraph-Printer."

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NOTICES OF BOOKS.

Napoleon's Campaign in Poland, 1806-1807. By F. LORAINE PETRE. London: Sampson Low, Marston & Co. 1901.

Mr. Petre has produced a work which would, in fact, be all that he claims for it, if it had not unfortunately happened that the same subject had been previously made the object of particular study and research by one of the most highly qualified specialists on the Napoleonic epoch, viz., Colonel von Lettow-Vorbeck, of the Military History Section of the German General Staff, who published his work in 1896 and was generally known to be engaged upon it in 1890. Mr. Petre is evidently quite unaware of the existence of von Lettow-Vorbeck's work, and it is a pity, therefore, that when working up for his subject, he did not address an inquiry to the authorities of the Royal United Service Institution, as to what works they might have in their valuable library bearing on the campaign in question, as willing assistance there is rendered to anyone who is ready to accept the often thankless task of developing and extending the scanty military literature available in this country in our own language.

The campaign the author has chosen, is perhaps the most interesting of all to the military student, as it was the first in which the revolutionary system of living on the country broke down and brought the Emperor face to face with the difficulties of supply with which our own oversea expeditions have made us so painfully familiar. In our

opinion, however, Mr. Petre fails adequately to appreciate the extraordinary wide-reaching influence these difficulties exercised, for neither men nor officers from the Emperor downwards in the French Army had had experience of these, to them, new conditions, and it was impossible in the time available to secure the satisfactory working of an improvised system. It was useless for the Emperor to multiply precautions and issue orders when the whole Army was ignorant of the necessity for such precautions and the need for the strictest obedience, a need which had not made itself felt in the same degree in previous campaigns.

The Emperor himself rose fully to the situation, his orders as far as they went were above reproach, but he had not, as he should have had, a trained staff to relieve him of the details, and already there was in the French Army a marked difference between the giving of an order and getting it obeyed. Without a due appreciation of the gulf that may lie between these two factors no rational criticism of a campaign is possible. Just as an engineer who designs a bridge with stresses on the members its material will not stand, will assuredly lose his reputation, however skilful the design, so will it happen to a general who gives orders that his men are not habituated to carry out, and thus it must have happened to Napoleon—had not his enemies been in even a worse case than himself. But this is by no means apparent from Mr. Petre's work; his sketches of the two contending Armies are good as far as they go, but particularly with regard to the French Army he only skirts the subject, and gives the reader no idea either of the difficulties Napoleon had to contend with or the real inadequacy of the means he employed to overcome them. Even von Lettow-Vorbeck hardly goes far enough in this direction, but then he is writing for expert readers, who are as familiar with the internal history of the French Army, its rise, growth, and decay, as they are with the daily affairs of their own ; to them a hint is sufficient ; for us, so great is the ignorance on these questions, that a whole book would be needed to prepare the mind of the general reader to appreciate Napoleonic strategy at its true value.

This is the fatal stumbling-block of all English and American criticism of the great Emperor's career. To them an Army is an Army—so many guns, horses, and foot soldiers ; of the infinite gradations of quality which may exist between given Armies, even from day to day they have not the slightest conception. When in the life of their hero they come upon the episode of a campaign, they look up their favourite authority on strategy, never pausing to analyse the special conditions under which he lived and wrote, trace the movements of the contending forces by a diary on the map, and apportion praise or blame as it suits their judgment, entirely unaware that there are no absolute rules in strategy, but only relative relations of the contending forces which can only be judged right or wrong as the event decides.

As a case in point, take the positions of the French and Prussians on the eve of the battle of Jena ; if the rules of strategy mean anything, never was an Army in the event of defeat in a more precarious position than the French. Thrown back upon the Bohemian frontier, not a man would ever have escaped back to his native land, whereas the Prussians had still more than half their country to retire into ; but Napoleon was a better leader of men than his adversaries, and, judging the fighting temper of his Army correctly, he turned the most serious situation of his life into the most brilliant of his successes.

In 1807 he was far more cautious, in no single battle did he stand to win or lose all, and in so far he abundantly justified all his panegyrists have claimed for him ; but also he failed to win a single decisive victory, his horses no longer being in a condition to pursue.

Another point which von Lettow-Vorbeck brings out, which has escaped Mr. Petre, but which is essential for the appreciation of his strategy, is the true relation of the Emperor to his country, and the influence this exercised on the prosecution of the campaign. It is the custom to represent him as untrammeled master of the whole of France's wealth and resources, but this was very far from being the estimate he formed of his own position. He could indeed impose on foreign courts by the assumption of a power he did not possess; but in his dealings with his countrymen he had to be very circumspect. At the outbreak of the war he had only 194,171 men at his disposal to hold the whole line of communication from Mainz to Posen—500 miles—to watch the coasts, to hold down Russia and Westphalia, and to make head against his enemies, and of these only 162,000 men were French subjects. To supplement these he had recourse during the campaign to two anticipations of the conscription—amounting each to 80,000, of whom 20,000 were to remain in reserve at home and many of these were only 19 years of age. The annual contingent available under the law from 38,000,000 should have been 250,000 at least, yet until the turn of the Russian campaign of 1812, against him he never called out from any one class more than 120,000 men.

Frederic the Great in 1756, out of a population of 4,000,000 placed 80,000 men in the field, exclusive of "foreigners" and volunteers, or more than double the above percentage of the population, and to come to more recent times in 1900, Great Britain with a population of 40,000,000 enlisted voluntarily no fewer than 100,000 men, and has maintained 250,000 in the field for two years without even the threat of compulsory service.

Neither in the matter of money was the great Corsican as unrestricted master as is generally supposed. Whatever foreign courts might think, it is evident that he himself knew well the opposition his demands would meet, for even when the whole operation depended on the money available at the front, and the men were months in arrear of pay, he did not venture to suggest a remittance from Paris. Practically, the whole expense of the campaign, the food for his soldiers on the march, their uniforms, saddles, horses, all were wrung out of the treasuries of his unfortunate German "allies," who also had to furnish nearly 100,000 troops to assist in the subjugation of their fellow countrymen. These points, which von Lettow-Vorbeck has been the first to bring out in their proper proportions, add enormously to one's opinion of the man who surmounted the difficulties they created, and also raises the question whether our own methods of feeding armies and raising troops at that date were not sounder than we have been taught to believe. If the Peninsula Army under the Duke, as it existed three years later, could have been landed in the Baltic, about Königsberg, would not our ready-money purchases for provisions have enabled us to subsist when the French Army and the Russians starved? The Polish Jews, von Lettow-Vorbeck points out, held the key of the whole situation.

We can only regret that Mr. Petre was unacquainted with this fascinating work. His own is readable and interesting, but with this mine of original information to draw on, with his industry and talent, together with his power of description, he might have conferred a lasting benefit on English military literature; as it is, he has rendered a real service in giving us a picture of what fighting meant in the old days and with the old weapons, which we commend to those who lost their heads after the recent engagements at Colenso and on the Tugela. What would London have said to the following butcher's bill, which is stated rather too low than the reverse? Out of 67,000 French engaged at Eylau: 4,893 killed, 23,589 wounded, 1,152 prisoners. Total, 29,634 = 44·3 per cent. Augereau's Corps, the VIIth, lost 5,200 out of 14,588 = 41 per cent., practi-

cally in one rush which lasted about 20 minutes. Morand's Division, 3,061 or 47½ per cent. in several hours of hard fighting. Soult, 34½ per cent. The Russians lost nearly as many.

In a notice of Mr. Petre's book, which appeared in the *Times Literary Supplement*, 17th January of this year, there is a rather careless blunder on the part of the reviewer. He says :—

"And appropriately Mr. Petre is at his best in the closing scene of the bloody drama when he describes the horrors of the Russian *débâcle* at Friedland, with burning bridges over a fordless river, where the fugitives were being dragged under *ice* by their accoutrements."

Mr. Petre says nothing about *ice*, nor was the Aller fordless, for as a matter of fact the bulk of the Russian Army retreated over the river by fords above and below the burning bridges, which, although deep, were quite passable ; but he does mention that the date of the battle was the 14th June, and states that the weather was very hot ; and Friedland is well within the temperate zone latitude.

Behind the Scenes in the Transvaal. By DAVID MACKAY WILSON. London, Paris, New York, and Melbourne : Cassell & Co., Ltd. 1901.

The title of this book suggests a repetition of "The Transvaal from Within," and not a few persons may consequently feel inclined to let it pass upon the pretext that their information upon the subject of "Krugerism" is already complete. Actually there are no grounds for such a supposition. The fact of having read Mr. Fitz-Patrick's book, so far from destroying the interest in that of Mr. Mackay Wilson, has just the contrary effect ; and, moreover, whilst the former appeals chiefly to the serious reader who reads to learn, the latter cannot fail to find numerous admirers amongst all classes, since amusement is excellently combined with instruction. The personal element is seldom absent throughout Mr. Wilson's pages, and he never fails to present the ludicrous as well as the more important aspect of the incidents that he describes.

Born in the Cape Colony and with the Taal at his finger-ends, Mr. Wilson emigrated to the Transvaal under conditions that enabled him to become merged, as it were, in the population of that country, and thus gain opportunities for becoming acquainted with the every-day life and characteristics of the inhabitants, official and otherwise, that under different circumstances could scarcely have been within his reach.

Smarting under a petty grievance that on account of its mean origin was the more annoying, Mr. Wilson trekked north into the Transvaal in 1884, arriving at Pretoria whilst Kruger was in England squeezing terms out of the flabby British Government of that time. This was fortunate, since in the absence of the President, old Jacob Maré represented the Government and thought fit to discharge the obligation of old acquaintanceship by appointing Mr. Wilson mining commissioner of the De Kaap Gold Fields. Maré was an influential man of considerable wealth, and his *protégé* consequently became also a favourite of Kruger, whose gratitude or approbation was subsequently earned by means of useful advice given at a time when the State was on the verge of bankruptcy. Mr. Kruger, when introducing Mr. Wilson to any person, appears to have neglected no opportunity of recalling his opportune services to the Republic, and in no case, except when the financial interests of his own family were involved, did he ever fail to give support when it was needed. The result would seem to have been that although Mr. Wilson, whilst a gold commissioner, was debarred

from private speculations, he nevertheless made money afterwards. Moreover, by the very rectitude of his dealings whilst an official, he earned the confidence of many burghers, and consequently a great deal of information that should serve to make him very rich in the immediate future.

It is already known that the mineral and other wealth of the Transvaal has hitherto been developed, subject to a proper enrichment of the Kruger clan and clique, and to deductions incurred owing to the necessity for propitiating the "Third Raad." But until now the exact details of sundry nefarious transactions that were regarded as matters of course, have not been fully explained. Under all the circumstances it is truly marvellous that the mining industry has been so successful as it has been; but what is more important is the well-established fact that under a just Government the business possibilities of all descriptions must speedily become something almost passing belief. The richness of South Africa is, of course, founded upon its mineral wealth, but it will be in the trade arising from the pursuit of it that the actual benefit to the many must accrue. To learn how prosperity has been hindered by the rapacity and corruption that have hitherto prevailed, and what great things the future assuredly has in store, no one can do better than consult Mr. Wilson's book.

In Chapter XVIII., under the heading "If I were Autocrat," the author explains what should, in his opinion, be done in order to ensure the peaceful settlement and prosperity of the new Colonies. This is the most important chapter in the book, and the reader will probably come to the conclusion that if indeed Mr. Wilson could actually be given a free hand to work upon the lines suggested by him, a successful issue would be very likely to result. The question of who and what should be retained under the British *régime* is dealt with in a manner that is at once simple and convincing.

That Mr. Wilson has actually been, as he alleges, "Behind the Scenes," is perfectly apparent to the reader, and the book is none the less attractive, because many parts of it are so delightfully amusing. The ridiculous side of things never escapes the author, and he tells his yarns in such a dry fashion that the entire value of every joke is invariably obtained.

In a word, whether read in order to gain information or merely in order to beguile the leisure hour, this book equally commends itself.

PRINCIPAL ADDITIONS TO LIBRARY DURING FEBRUARY, 1902.

China and the Powers—A Narrative of the Outbreak of 1900. By H. C. THOMSON. 8vo. London, 1902.

Geological Survey of Canada. General Index to the Reports of Progress, 1863 to 1884. Compiled by D. B. DOWLING. 8vo. Ottawa, 1900.

Alaska—Giving the Results of the Harriman Alaska Expedition, carried out with the Co-operation of the Washington Academy of Sciences. By JOHN BURROUGHS, JOHN MUIR, and GEORGE BIRD GRENNEL. 63s. Imp. 8vo. London, 1902.

Smithsonian Institution. Annual Report of the Board of Regents for the Year ending June 30th, 1900. 8vo. Washington, 1901.

War Notes.—The Diary of Colonel de Villebois-Mareuil, from November 24th, 1899, to April 4th, 1900. Authorised translation from the Paris *Liberté*. By FREDERICK LEES. 2nd Edition. 5s. 8vo. London, 1902.

Bird Hunting on the White Nile. By H. F. WITHERBY. 2s. 6d. 8vo. London, 1902.

The Mastery of the Pacific. By A. R. COLQUHOUN. 18s. 8vo. London, 1902.

Chaudières Marines. By L. E. BERTIN. 8vo. Paris, 1902.

On Active Service with the Chinese Regiment. By Captain A. A. S. BARNES. 5s. Crown 8vo. London, 1902.

Tagebücher des Generalfeldmarschalls Graf von Blumenthal 1866 und 1870-1871. By ALBRECHT GRAF VON BLUMENTHAL. 8vo. Berlin, 1902.

Finland—Its Public and Private Economy. By N. C. FREDERIKSEN. 6s. 8vo. London, 1902.

Cromwell's Army. By C. H. FIRTH. 7s. 6d. 8vo. London, 1902.

Histoire de la Marine Française depuis les Débuts de la Monarchie jusqu'au Traité de Paix de 1763. By E. CHEVALIER. 8vo. Paris, 1902.

Die Occupation Bosniens und der Herzegovina. By VINZENZ VON HAARDT. 8vo. Vienna, 1878.

The Battle of Chancellorsville—Jackson's Attack. By A. C. HAMLIN. 8vo. Bangor, Maine, 1896.

The Beginning of South African History. By G. McC. THEAL. 16s. 8vo. London, 1902.

Field Training of a Company. By Major H. J. CRAUFURD. 2s. 6d. Demy 12mo. London, 1902.

La Bataille de Jemappes. Publié sous la direction de la Section Historique de l'État-Major de l'Armée. By C. DE LA JONQUIÈRE. 8vo. Paris, 1902.

Report on the Military Operations in Ashanti, 1900. By Major H. R. BEDDOES. 8vo. London, 1901.

The Moors. By BUDGETT MEAKIN. 8o. London, 1902.

Head Hunters, Black, White, and Brown. By A. C. HADDON. 8vo. 15s. London, 1901.

Afoot through the Kashmir Valleys. By MARION DOUGHTY. 8vo. 7s. 6d. London, 1902.

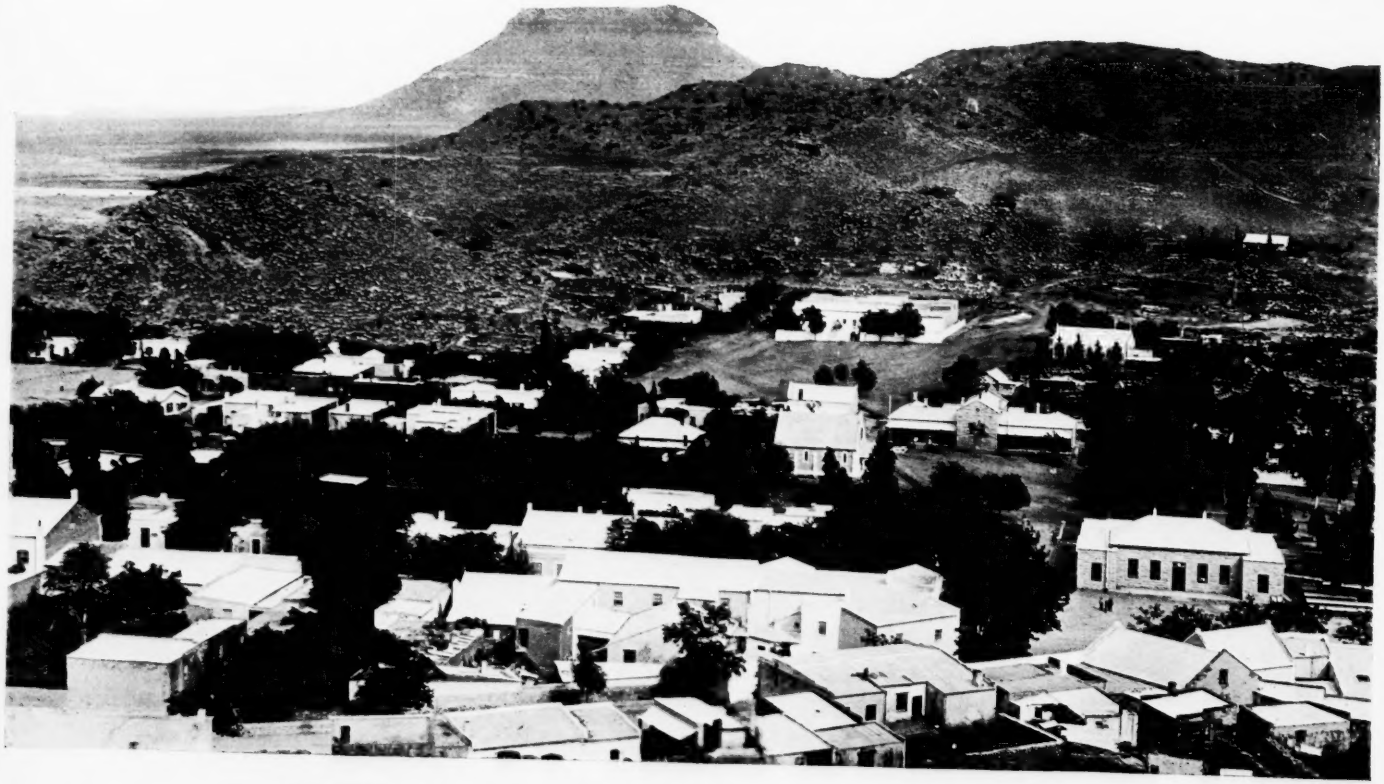
The Ancient Ruins of Rhodesia. By R. N. HALL and W. G. NEAL. 8vo. 21s. London, 1902.

König Albert von Sachsen. By Dr. PAUL HASSEL. I. und II. Theile. 8vo. Berlin, 1898.

Geschichte des Infanterie-Regiments Markgraf Ludwig Wilhelm (3. Badisches) No. III. By Major FEILL. 8vo. Berlin, 1897.

Geschichte des Kürassier-Regiments Kaiser Nikolaus I von Russland (Brandenburgischen) No. VI. By First Lieutenant FRIEDRICH VON RESTORFF. 8vo. Berlin, 1897.

Guerre de 1870-71. État Nominatif par Affaires et par Corps des Officiers tués ou blessés de la première partie de la Campagne (du 25 Juillet au 29 Octobre). By A. MARTINIAU. 8vo. Paris, 1902.



THE TOWN OF COLESBERG, CAPE COLONY, SHOWING COLESKOP IN THE BACKGROUND.

J. J. K. & Co., Ltd., London.

See Military Notes (South Africa).

MARCH JOURNAL.

ERRATUM.—Page 307, line 35.—For "Preventing" read "Promoting."